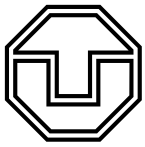

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Dissertation

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Using Information Systems to Enable Managerial Accounting at Small and Medium Sized Manufacturing Firms in Germany

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List of Abbreviations

ADF	Asymptotic Distribution Free
adj	adjusted
AGFI	Adjusted Goodness of Fit Index
AIS	Association for Information Systems
ALN	Adaptive Learning Approach
BSC	Balanced Scorecard
BPG	Business Policy Game
CBIS	Computer-Based Information System
CD	Coefficient of Determination
CEO	Chief Executive Officer
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CFO	Chief Finance Officer
CI	Confidence Interval
Coef.	Coefficient
Conf.	Confidence
const.	constrained
df	Degrees of Freedom
DP	Data processing
DSS	Decision Support System
ERP	Enterprise Resource Planning
ES	Enterprise System
GLS	Generalised Least Square

HTML	Hypertext mark-up language
ICIS	International Conference on Information Systems
ICV	Internationaler Controller Verein
IfM	Institut für Mittelstandsforschung
insb.	insbesondere
IS	Information System
IT	Information Technology
KMS	Knowledge Management System
LISREL	Linear Structural Relations
LV	Latent Variable
MBA	Master of Business Administration
mc	Multiple Correlation
MIS	Management Information System
ML	Maximum Likelihood
MR	Multivariate Regression
MV	Manifest Variable
NAICS	North American Industry Classification System
OLPM	Online Portfolio Management System
OS	Operating System
PC	Personal Computer
PHP	Personal (Homepage Tools) Hypertext Preprocessor
PLS	Partial Least Square
Pr	Probability
QS	Qualitätssicherung
RGB	Red Green Blue
RMSEA	Root Mean Squared Error of Approximation

SEM	Structural Equation Modelling
SIS	Student Information System
SLUB	Sächsische Landes- und Universitätsbibliothek
SME	Small and Medium Sized Enterprise
SMTP	Simple Mail Transfer Protocol
SRMR	Standardised Root Mean Squared Residual
Std. Err.	Standard Error
TAM	Technology Acceptance Model
TLI	Tucker-Lewis Index
TRA	Theory of Reasoned Action
TTF	Task-Technology-Fit
TU	Technische Universität
UDA	User-Developed Application

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1 Introduction

The first chapter provides an introduction to this dissertation. It presents the research question and its relevance for academia and practice. Next, it outlines the course of the investigation and the epistemological stance. Finally, it discusses some key terminology which will bear on all the subsequent chapters.

1.1 Research Question

Information systems (IS) research encompasses a broad area of research topics with relevance both for scholars and practitioners. Robey observes that “in IS, diversity is evidenced by the variety of topics being addressed, the number of theoretical areas being referenced, and the range of specific methods being employed in IS research” (1996, p. 401). He describes how “diversity in IS expands the foundation upon which knowledge claims in the field are based” (Robey, 1996, p. 403).

This dissertation intends to contribute new aspects to the field while building upon established streams of research. It revolves around the conjunction of information systems, managerial accounting and small and medium sized enterprises (SMEs). While each of these topics is interesting in itself, the dissertation sets out to answer the following research question combining the three:

Which factors contribute to an information system’s success in enabling managerial accounting at small and medium sized manufacturing firms in Germany?

In 2007, manufacturing firms in Germany had incurred expenses of about EUR 3bn and undertaken investments of more than EUR 1bn related to software. This puts them ahead of any other industry. (Feuerhake & Bundil,

2007, p. 561) The monetary commitment these firms make underlines the important role which software plays for them. Furthermore, the greater the investment, the greater the return should be. While these expenses and investments relate to software in general, information systems nevertheless have to contribute their part to the returns.

The need for adequate returns is compounded further when dealing with SMEs. In contrast to large corporations, SMEs are marked by “resource poverty”, a term used by Welsh and White (1981, p. 2) to describe the unique circumstances of these firms. They observe that “owner-management of a small business is a distinct discipline characterized by severe constraints on financial resources, a lack of trained personnel, and a short-range management perspective imposed by a volatile competitive environment” (1981, p. 12). Under these conditions, the deployment of an IS holds both a great potential for improvement, and a great threat of failure. An IS might help to alleviate the effects of resource poverty, but the related financial and organisation burdens might also aggrevate the problem. If choosing to deploy an IS, its success is of paramount importance to SMEs.

One particular area of application for IS at SMEs is managerial accounting. Its primary purpose is to complement the information and decision basis of management. (Bruns & McKinnon, 1993, p. 84; Deyhle, 1993, pp. 46-59; Küpper, Weber, & Zünd, 1990, pp. 282-284) However, managerial accounting research often “assumed the existence of a relatively large and stable organization” (Otley, 1994, p. 294). The benefits of managerial accounting may therefore not be replicated easily under the distinct circumstances of SMEs.

Manegold, Steinle and Krummaker (2007, pp. 15-16) identify inconsistent support of information technology (IT) and IS for managerial accounting as a major challenge for SMEs. Based on their investigation of managerial accounting at SMEs, they put forth a number of recommendations for improvement, in which they describe an information system as the backbone of managerial accounting (Manegold et al., 2007, p. 58). Kosmider (1991) has

conducted a quantiative empricial survey among German manufacturing SMEs to investigate the current status and evolution of managerial accounting. He found that the implementation of a software-driven information system for managerial accounting is a high priority for these firms (Kosmider, 1991, p. 184). Similarily, Lohr (2012) has investigated the specificities of managerial accounting at the same kind of companies in a qualitative empirical study. He concludes that “information systems have been shown to be necessary in order to enable successful and efficient managerial accounting” (Lohr, 2012, p. 52).

All three studies highlight the importance of managerial accounting for SMEs and the pivotal role of information systems for its successful execution. Thus, when properly supporting managerial acounting, an IS can contribute directly to lessen a firm’s burden of resource poverty.

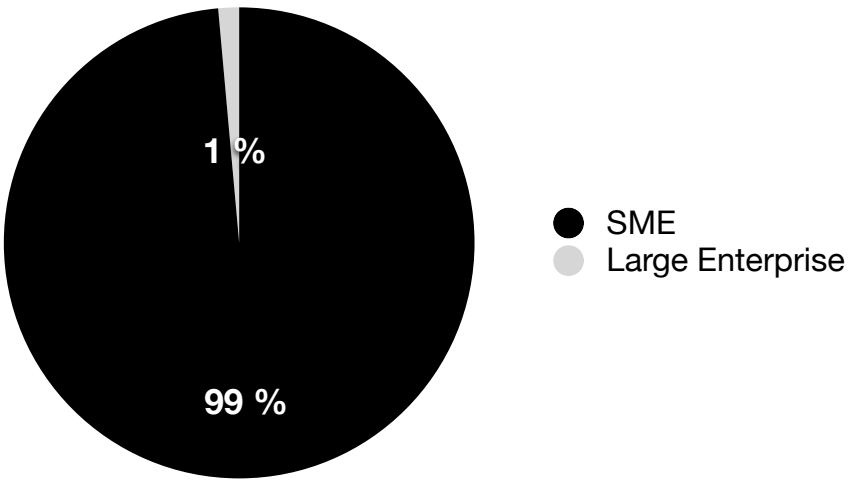


Figure 1: Proportion of SME manufacturing firms in Germany.
Adapted from Destatis, 2011.

Figure 1 illustrates the proportion of SMEs in the manufacturing industry in Germany in 2011. They outnumber large enterprises by 99 to 1. This makes them an interesting and relevant object for investigating the factors which contribute to the success of their information systems with regard to managerial accounting.

1.2 Course of the Investigation

In order to investigate the research question, the dissertation is divided into five chapters which build upon each other. The arguments are developed sequentially, starting with the research question, then clarifying the theoretical foundations before outlining the research design, evaluating the results and drawing conclusions. Figure 2 depicts the sequence and coherence of the individual chapters.

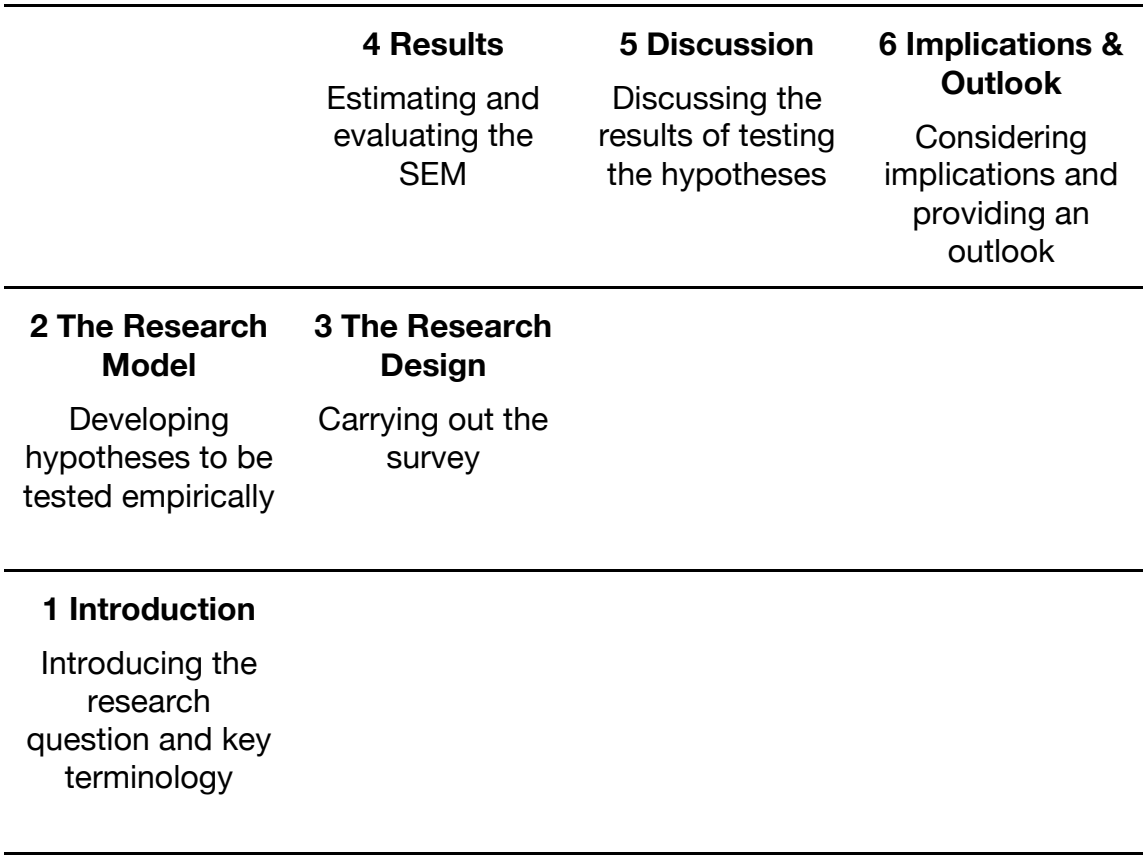


Figure 2: Course of the investigation.

Chapter 1 lays the foundation for the dissertation by introducing the research question and explaining why it is relevant for both academia and practice. It also outlines the course of the investigation and defines key terminology which will be important throughout the dissertation.

Chapter 2 explores various theories which could form a suitable basis for investigating the research question. The IS Success Model is the most suitable one with regard to the research question and is subsequently

adapted to the specific context of managerial accounting at SMEs. The outcome is a research model with 20 hypotheses pertaining to the interaction of factors contributing to IS success.

Chapter 3 translates the research model into a structural equation model, which can later be evaluated statistically in order to reject or not reject the hypotheses. It defines measurement variables and an appropriate answer scale. Next, it describes the steps undertaken to carry out the survey, including the design of the questionnaire, the results of pretesting and the final administration.

Chapter 4 evaluates the empirical data obtained from the survey. The evaluation comprises a description of the sample and of the manifest variables, as well as an examination of a potential response bias. Most importantly, however, it estimates the parameters of the structural equation model, which constitutes the empirical test of the hypotheses. After also assessing model fit in general, the results lead to the rejection of 6 hypotheses, whereas the remaining 14 cannot be rejected.

Chapter 5 discusses the results of the empirical study and the consequences for the 20 hypotheses. This includes a comparison to other similar studies. Another point that is being discussed are the negative attitudes which repondents have indicated in the survey.

Chapter 6 deals with the implications of the empirical results with regard to the research model and IS success research in general. It also comprises a clear demarcation of the limitations of this study. The chapter concludes the findings with respect to the research question. Finally, it indicates a course for future research by outlining a potential qualitative investigation which might subsequently complement this study.

1.3 Epistemology

This dissertation assumes a positivist quantitative epistomological stance. It supposes that the objects being investigated are real and that their characteristics can be measured and expressed as data. The data obtained will subsequently allow for testing causal relationships between the objects. (Straub, Boudreau, & Gefen, 2004, p. 381)

1.4 Key Terminology

1.4.1 Information System

A definition by Davis and Olson from 1985 sees a management information system as “an integrated, user-machine system for providing information to support operations, management, and decision-making functions in an organization. The system utilizes computer hardware and software; manual procedures; models for analysis, planning, control and decision making; and a database” (Davis & Olson, 1985, p. 6). This definition stems from a time when specific software applications first emerged which allowed direct interaction with the user. It therefore still stresses the technical aspects of an IS. A similar definition is offered by Hicks: “An information systems (IS) is a formalized computer information systems that can collect, store, process, and report data from various sources to provide the information necessary for management decision making” (Hicks, 1993, p. 2).

Ahituv and Neumann extend upon the technical aspects and state that an IS is comprised of “people, hardware, software, data, and procedures” (Ahituv & Neumann, 1990, p. 2). The inclusion of people in the definition is also maintained by Hansen and Neumann (2002, pp. 133-134) for IS research in Germany. Silver, Markus and Beath quote the following definition, which they see as the standard textbook definition: “An information system consists of ‘hardware, software, data, people, and procedures.’” (Silver, Markus, & Beath, 1995, p. 363) They also argue that a student’s or business executive’s point of view might be different: “Here, the organization or enterprise is the

supersystem, containing, among other things, people, business processes, and information systems" (Silver et al., 1995, p. 363).

This dissertation is based on the more inclusive definition of an IS, as it takes into account that people operate and interact with the IS. People are the ultimate source of information for the investigation in this dissertation and they constitute an important aspect of the IS.

In addition to a definition for IS as software, it is also interesting to look at the field of IS research. Adam and Fritzgerald perceive a "definitional quagmire" (1996, p. 20) of IS research as pertaining both to definitions of the term "information" and the concept of "information systems" itself. (Adam & Fitzgerald, 1996, p. 20) Consequently, a uniform definition of the field is not possible. Avgerou finds that this lack of a definition is due to the nature of the research field: "It is generally felt that the variety of research topics and approaches, the interdisciplinary sources of theory used, and the methodological pluralism found in the field are necessary to cope with the complex nature of the phenomena studied" (Avgerou, 2000, p. 568).

Rather than trying to pin down a definition for IS research, it may be more adequate to look at what it comprises. Swanson and Ramiller (1993) have analysed the submissions to the journal "Information Systems Research" since its founding in 1987 up until 1992. Their intention is to foster debate about the future thematic emphases of the journal. For their argument, the have grouped the submissions into several thematic categories, which are connected and related. Figure 3 reproduces their graphical map of the different themes. It illustrates the diversity within IS research (Benbasat & Weber, 1996; Robey, 1996).

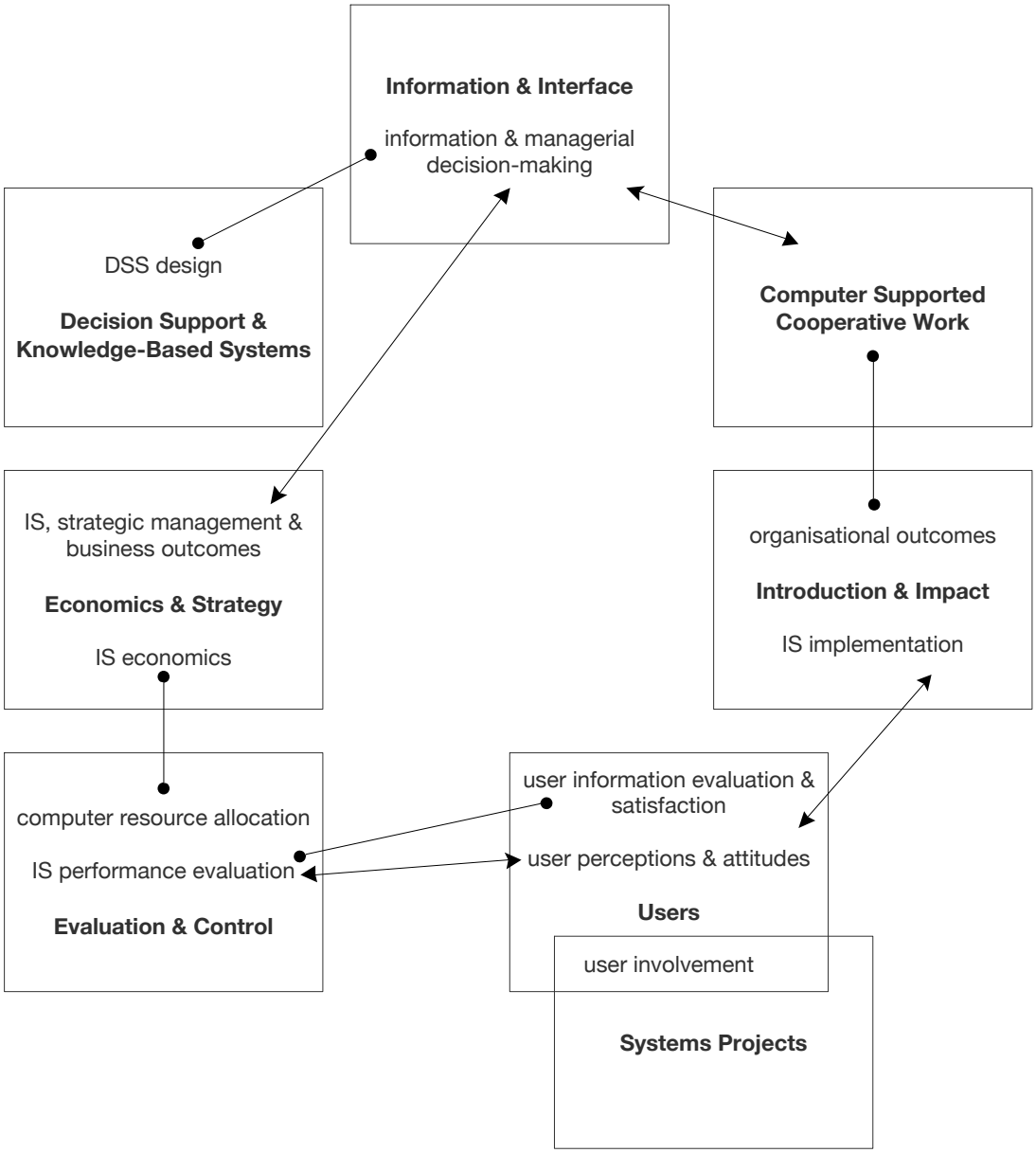


Figure 3: Thematic areas and their connections in IS research.
Adapted from Swanson & Ramiller, 1993, p. 319.

1.4.2 Managerial Accounting

In the Anglo-Saxon world, the expression “Management Control” is used to describe activities such as planning, coordination, evaluation, deciding and influencing. (Anthony & Govindarajan, 2007, pp. 6-7; Mockler, 1970, p. 73) However, since this dissertation aims at investigating managerial accounting at German companies, a definition stemming from German literature is more

appropriate. There are differences between the Ango-Saxon concept of managerial accounting and the German concept of “Controlling”, but the commonalities are sufficient to warrant the use of the English term throughout this dissertation.

Conceptual explanations of what managerial accounting is can be grouped into three different categories. The first is the one of accounting-oriented concepts according to which managerial accounting draws on the information generated by accounting systems to provide management with future-oriented monetary analyses. In the second concept, managerial accounting not only includes monetary figures but encompasses all parts of the company. Subsequently, managerial accounting gathers, aggregates and analyses information for the purpose of which it runs and maintains Management Information Systems (MIS). The third depicts managerial accounting as a “broad management function” (Mockler, 1970, p. 76). When a company has grown in size as to require the direction of its activities by plans, managerial accounting coordinates all concerted efforts of management. (Küpper, 1997, pp. 464-465; Niedermayr, 1994, pp. 16-22; Pietsch & Scherm, 2000, p. 396; Schäffer, 2001, pp. 125-126; Weber, 2001, p. 159) The Internationaler Controller Verein (ICV) sees managerial accounting as a joint activity of managers and managerial accountants. They attribute four activities to managerial accountants: planning, informing, analysing and steering. (Internationaler Controller Verein, 2005)

As these three concepts can be regarded as extensions of one another, a fourth approach, which is predominantly led by Weber and Schäffer, defines managerial accounting as ensuring the rationality of management. (Schäffer, 2001, p. 127; Weber, 2004, pp. 47-49; Weber & Schäffer, 1999, pp. 734-740) In that context, “rationality” is understood as the best cost-benefit-ratio. Rationality is challenged when goals need to be achieved that seem to defy leading trends in the industry or the convictions of individuals. (Weber, 2004, pp. 50-52) This fourth approach is particularly significant when managers delegate certain tasks to managerial accountants. Depending on whether the

manager (a) does not have time to fulfil the task, (b) does not have the ability to do it or (c) is prone to opportunistic behaviour, a managerial accountant's function will be of a supportive, complementary or limiting nature. (Weber, 2004, pp. 38-44) Within this framework of functions, however, a managerial accountant will still have to accomplish his elementary tasks (Hahn, 1982, pp. 21-22).

As can be seen, there is no common definition of managerial accounting. For this dissertation, the definition of Schäffer and Weber will be applied since its segmentation into functions encompasses most of the tasks attributed to managerial accounting by the other three concepts mentioned before and it allows for evaluating how these functions translate to SMEs and how they are being supported by information systems.

1.4.3 Small and Medium Sized Enterprises

There is no uniform definition of SMEs. However, SMEs can be distinguished from other types of firms by both quantitative and qualitative criteria. (Kosmider, 1991, pp. 29-30; Manegold et al., 2007, p. 3) The Institut für Mittelstandsforschung (IfM) in Bonn is a leading German research institute specialised in SMEs. They offer a quantitative classification, wich is represented in table 1.

	Number of Employees	**Annual Turnover in EUR**
Small	up to 9	less than 1m
Medium	10 – 499	1m – 50m
SME in total	up to 499	less than 50m
Large	500 and more	50m and more

Table 1: SME definition of the IfM.
As of January 1st, 2002, adapted from IfM, 2012.

The European Commission provides another classification. They argue that a European definition is necessary in order "to limit distortions of competition

... to help SMEs in areas such as regional development and research funding" (European Commission, 2012, p. 6). Table 2 shows their quantitative criteria.

	Headcount	**Annual Turnover in EUR**	**Annual balance sheet total**
Micro	fewer than 10	up to 2m	up to 2m
Small	fewer than 50	up to 10m	up to 10m
Medium-sized	fewer than 250	up to 50m	up to 43m

Table 2: SME definition of the European Commission.
As of January 1st, 2005, adapted from European Commission, 2012, p. 14.

Qualitative criteria of SMEs are also diverse. Kosmider (1991, pp. 30-33) summarises the following key characteristics: legal and economic independence; legal form; company structure focused on the entrepreneur; limited access to capital markets; and a clear and informal organisational structure.

Furthermore, many SMEs are also family businesses for which quantitative criteria do not exist. A key characteristic of a family business is the unity of control and ownership. This means that those shareholders whose capital stock grants them significant influence also run the company, possibly together with non-shareholding managers. As a consequence, the company can make decisions quickly and thus respond to market developments. (IfM, 2007, pp. 3-6)

For this dissertation, the quantitative definition of the IfM will be applied as its offers a more inclusive classification of SMEs. The criteria highlighted by Kosmider also apply, even though not all of them may be equally relevant to the companies in this study. While the aspect of family businesses is not investigated here, it is likely that many companies in this survey are indeed family businesses.

2 The Research Model

The research model comprises the theoretical foundation for the investigation and establishes its place within IS success research. It is furthermore an important first step in assuring the validity of the results which are to ensue from the investigation. Boudreau, Gefen and Straub (2001), who have examined validation in IS research, caution that “within the positivist, quantitative area of research, the very scientific basis of the profession depends on solid validation of the instruments that are used to gather the data upon which findings and interpretations are based” (Boudreau et al., 2001, p. 2). Their article builds on prior work by Straub (1989) who prescribed, among other things, that “researchers should use previously validated instruments wherever possible, being careful not to make significant alterations in the validated instrument without revalidating instrument content, constructs, and reliability” (Straub, 1989, p. 161). Chapter 2 is about deciding which previously validated instruments to incorporate in this dissertation and which constructs need to be modified or created anew. The statistical validation of the research model is conducted in chapter 4.

The first section in this chapter deals with the question of how to determine the success of an IS. Competing models are presented and their merits with regard to this disseration are being discussed. The IS Success Model turns out to be the most appropriate choice of theoretical foundation. Section 2.2 examines it in detail. Finally, section 2.3 adapts the IS Success Model to the specific requirements of this dissertation and establishes the complete research model with its related research hypotheses. This forms the basis for the subsequent empricial investigation.

2.1 How to Determine IS Success

2.1.1 A Brief History of Personal Computers

This chapter and this dissertation as a whole make an implicit assumption: Our current understanding of IS depends on the user having direct access to the system. While this may appear to be an obvious assumption, it would not have been so 30 years ago. The relationship between computers and users has evolved over time and been made possible in its current form by the advent of the personal computer (PC). Chapter 2 evaluates approaches of and draws up a model for determining IS success in light of the close interaction between users and their computers at their places of work.

In an empirical field study among large US companies in the 1980s, Guimaraes and Ramanujam (1986) have shown that the percentage of companies in the sample using personal computing had increased from 8% to 100% in the 1980 to 1984 timeframe (see figure 4). The trend towards adopting personal computing had been continuous and swift. Another metric shows that in the year 1984, 9% of total computing was performed on PCs. This had profound implications for the role of MIS departments and employees alike.

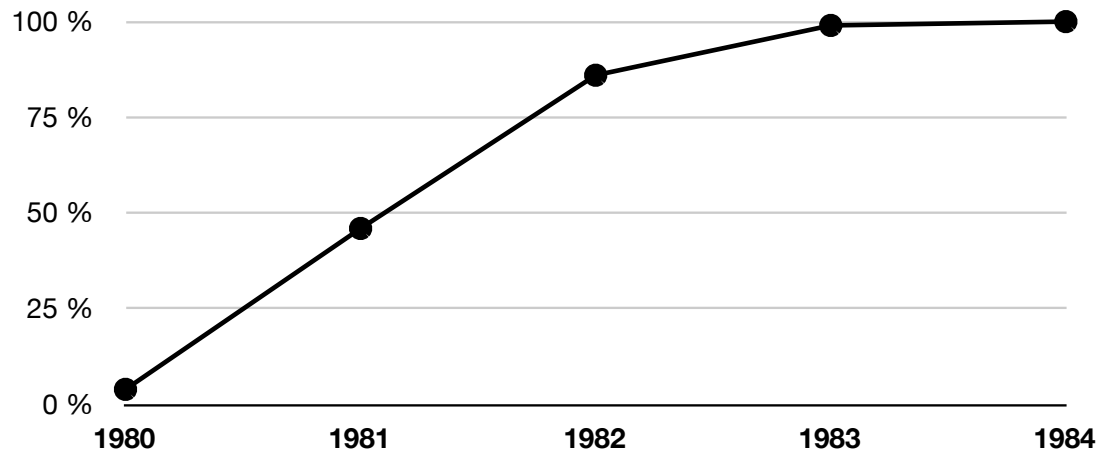


Figure 4: Personal computer usage between 1980 and 1984.
Adapted from Guimaraes & Ramanujam, 1986, p. 183.

End-User Computing was a new concept and brought with it far-reaching changes. A definition by Benjamin (1982) exemplifies how these changes were perceived at the time: “End User Computing – a difficult term to define with great clarity but heuristically defineable in terms of financial modeling, file retrieval and analysis, engineering modeling, use of outside databases, etc., all with the user in direct interactive control of the computer session.” (Benjamin, 1982, p. 14)

With a shift of focus away from mainframe computers towards PCs came an increased responsibility on part of the employee. While this responsibility in the past resided with the MIS department, end users now need to concern themselves with tasks involving the management of the information system. Osterman observes that “everyone knows that IT will reshape work. Everyone also knows that this reconfiguration will have deep impacts in the distribution of workers across occupations and firms and on the skills employees will be expected to bring to work.” (Osterman, 1991, p. 221)

Guimaraes summarises these newly emerged job requirements for users in the following way: “Personal computing represents the ultimate in user control over the computer facilities that satisfy user information requirements. The users purchase the equipment, develop customized applications, modify software packages, and handle their own data and telecommunication needs. In this way, the user-MIS department relationship can remain much less extensive than in the traditional DP [data processing] approach.” (Guimaraes, 1984, p. 4)

At the time, scholars perceived the change and introduced the concept of end-user computing or personal computing in contrast to mainframe computing. Guimaraes and Ramanujam observed that “almost every discussion on personal computing has emphasized the need to create greater awareness among users of the organization-wide impact of personal computing and the need for ensuring the integrity of both organizational data and applications.” (Guimaraes & Ramanujam, 1986, p. 182)

By the year 1984, the success or failure of an information system could no longer solely by judged by its technological characteristics. The user became an equally important factor in the interaction with the computer. Users did not have to be content anymore with just receiving answers; they were now in a position to ask questions.

This change in the relationship between users and computers had consequences for both sides. Users had to encorporate computers into their work processes and computers had to operate in a way that made it easy for users to do so. Thus, users' acceptance of technology became a major new research field.

2.1.2 Technology Acceptance Model

2.1.2.1 Origins

The Technology Acceptance Model (TAM) stems from Fred D. Davis' 1995 dissertation called "A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results" (Davis, 1985). In light of the ever-increasing prevalence of end-user computing, TAM aims at "improving the understanding of user acceptance processes, providing new theoretical insights into the successful design and implementation of information systems" (Davis, 1985, p. 7).

TAM adapts the general Theory of Reasoned Action (TRA) developed by Fishbein and Ajzen (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) for the purpose of specifically explaining the factors leading to the acceptance of information systems by end-users (Davis, Bagozzi, & Warshaw, 1989, p. 985). TRA postulates that a person's actual behaviour is determined by behavioural intentions. These in turn are a result of both attitudes towards the behaviour and of subjective norms. In line with TRA, TAM supposes that actual system use is determined by a user's Behavioural Intention to use it, while Behavioural Intention depends on his Attitude towards use. Unlike TRA, TAM does not consider social norms as a determinant of Attitude "because

of its uncertain theoretical and psychometric status" (Davis et al., 1989, p. 986). In order to explain Attitude, TAM introduces the two beliefs Perceived Usefulness and Perceived Ease of Use. Perceived Ease of Use is postulated to also influence Perceived Usefulness, whereas Perceived Usefulness is thought to have a direct effect on Behavioural Intention in addition to its indirect effect through Attitude. Perceived Usefulness and Perceived Ease of Use are supposed to be jointly determined by external variables. These two beliefs are defined as follows: "Perceived usefulness […] is defined as the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context. Perceived ease of use […] refers to the degree to which the prospective user expects the target system to be free of effort" (Davis et al., 1989, p. 985).

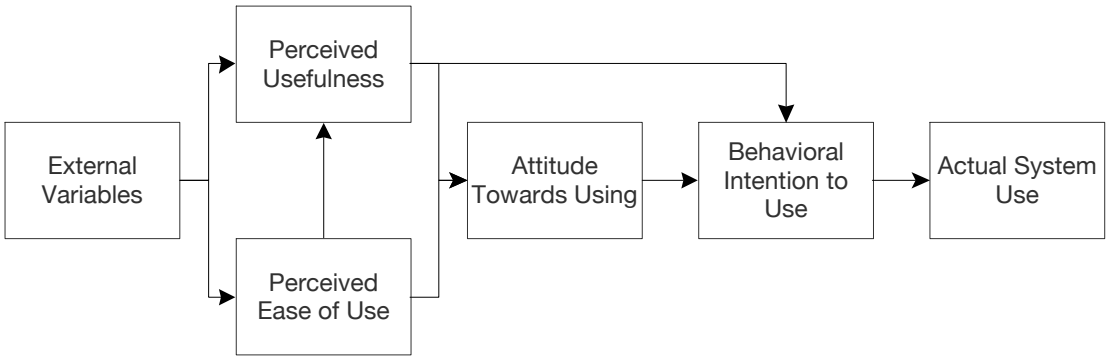


Figure 5: Technology Acceptance Model.
Adapted from Davis et al., 1989, p. 985.

In his dissertation, Davis tested the validity of his model with a structural equation model. The data was generated from questionnaires filled in by 112 IBM employees at their Toronto Development Laboratory (Davis, 1985, p. 93). The analysis showed strong and significant support for the postulated relationships between Perceived Ease of Use, Perceived Usefulness, Attitude and Usage and also revealed the direct relationship between Perceived Usefulness and Actual System Use (Davis, 1985, pp. 106-109). Later, Davis (1989) used the data from the original study to refine the measurement scales for Perceived Usefulness and Perceived Ease of Use. A laboratory study with

40 MBA students at Boston University suggested that “usefulness mediates the effect of ease of use on usage” (Davis, 1989, p. 332). Thus Davis not only developed a theory of factors determining user acceptance, but he also contributed a first instance of empirical support.

2.1.2.2 Reception

Since the publication of the two original articles by Davis and Davis et al. in 1989, TAM has steadily grown to become a widely accepted theory in IS research. This success is largely attributed to the parsimonious assumptions and relationships of the model, while still retaining the ability to statistically explain a large portion of the variance in the observed variables. (Bagozzi, 2007, p. 244; Benbasat & Barki, 2007, p. 212; Venkatesh & Davis, 2000, pp. 186-187; Venkatesh, Davis, & Morris, 2007, p. 268). The practical implications of these characteristics have been summarised by Lee, Kozar and Larsen: “Of all the theories … [TAM] is considered the most influential and commonly employed theory for describing an individual’s acceptance of information systems” (2003, p. 754).

In addition to these qualitative assessments, the success of the model can also be traced by the number of citations of the original two articles. Over the years, several authors have looked up this number in the Social Sciences Citation Index. Table 3 highlights their findings.

Year	**Citations**	**Source**
2000	424	Venkatesh & Davis, 2000, p. 187
2003	698	Lee et al., 2003, pp. 752-753
2007	1,000+	Venkatesh et al., 2007, p. 768

Table 3: Impact of TAM in terms of citations.

Not only are the absolute numbers a strong indication of the reception of TAM, but the annual increase in citations has more than doubled in the eleven years from 2000 to 2011 compared to the period between 1989 and 2000.

In light of the prevalent use of TAM in IS acceptance research, the question has arisen which further development the model itself should undergo. Benbasat and Barki state the question as follows: “After 17 years of research and a large multitude of studies investigating TAM … we now know almost to the point of certainty that perceived usefulness (PU) is a very influential belief1 [sic!] and that perceived ease of use (PEOU) is an antecedent of PU and an important determinant of use in its own right. Unfortunately, … in spite of its significant contributions, the intense focus on TAM has led to several dysfunctional outcomes” (2007, p. 212). Venkatesh, Davis and Morris (2007, p. 268) express their view that TAM is dead as far as continued “replications with no substantive theoretical advance” are concerned, but that there are “opportunities for future advances”. Examples for these advances may include attempts to unify TAM and other models in order to broaden its scope and depth of analysis (Bagozzi, 2007; Premkumar & Bhattacherjee, 2008; Venkatesh, Morris, Davis, & Davis, 2003).

2.1.2.3 Applicability

Having discussed the merits and pervasive use of TAM, it nevertheless does not fully apply to the research question. This dissertation sets out to examine characteristics of information systems, which ultimately lead to an improved ability to exercise managerial accounting. Usage – or technology acceptance – is insufficient in approximating the breadth required to answer the research question. While usage may turn out to explain a significant amount of the benefits derived from adapted information systems, other factors need to be investigated as well (e.g. the fit between the IS and managerial accounting concepts).

Even in the technology acceptance context, “only a handful of TAM studies have looked explicitly at the role of system characteristics as antecedents to ease of use or usefulness” (Wixom & Todd, 2005, p. 87). Therefore, most of the validation TAM has received over the years does not cover system characteristics as either a dependent or an independent variable.

While TAM may not be adequate to address the research question, it is still useful for understanding the usage and user satisfaction aspects of IS. In particular, it provides a rich pool of tested constructs (e.g. Al-Gahtani & King, 1999; Legris, Ingham, & Collerette, 2003; Wixom & Todd, 2005), which may well be applied in a different research framework.

2.1.3 IS Success Model

2.1.3.1 Origins

DeLone and McLean's 1992 paper attempts to create a parsimonious model for measuring IS success. Rather than for every researcher to define his own measure of IS success, which may be highly specific to the context and system under investigation, the field of IS research would benefit from a uniform tradition. Another advantage of such an evaluation model would be to render studies more comparable. Taking both of these factors together, DeLone and McLean recognise that "without a well-defined dependent variable, much of I/S research is purely speculative" (DeLone & McLean, 1992, p. 61).

As a first step towards deriving their IS Success Model, DeLone and McLean reviewed 100 publications over the timeframe January 1981 to January 1988. They included the following journals: Management Science, MIS Quarterly, Communications of the ACM, Decision Sciences, Information & Management, Journal of MIS and the ICIS Proceedings. (DeLone & McLean, 1992, p. 63) This review was meant to build on previous reviews by Ives, Olson and Baroudi (1983) and even earlier work by Zmud (1978).

Next, they sorted these publications into one or more categories: System Quality, Information Quality, Use, User Satisfaction, Individual Impact and Organisational Impact. These six so called "Categories of I/S Success" (DeLone & McLean, 1992, p. 62) were derived from theories on the value and dimensions of information. DeLone and McLean referred to the levels of a communication system by Shannon and Weaver (1963) and to the categories

of communication systems by Mason (1978). Their six categories were then assigned to their closest matching counterparts in the models in the two cited articles.

Having categorised the findings of their literature review, DeLone and McLean strive to reduce the number of potential dependent variables in IS success research and at the same time to account for the interdependency of the remaining variables (DeLone & McLean, 1992, pp. 80-83). They argue that “the process and ecology concepts from the organizational effectiveness literature provide a theoretical base for developing a richer model of I/S success measurement” (1992, p. 83). In their subsequent model, System Quality and Information Quality influence Use and User Satisfaction. In turn, Use and User Satisfaction are mutually dependent and jointly influence Individual Impact. Organisational Impact is ultimately determined by the influence of Individual Impact. Figure 6 illustrates the IS Success Model proposed by DeLone and McLean.

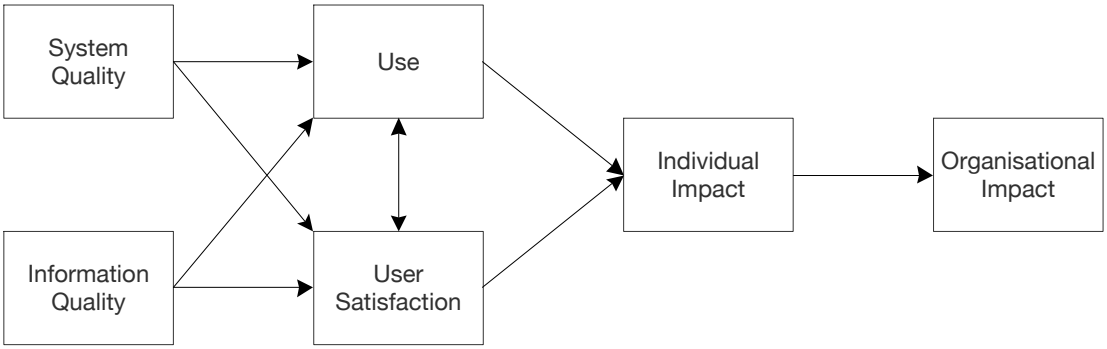


Figure 6: IS Success Model.
Adapted from DeLone & McLean, 1992, p. 87.

2.1.3.2 Reception

Over the years, DeLone and McLean’s model and its derivates have evolved to be “widely adopted” (Bernroider, 2008, p. 258) in IS research. But, as Gable et al. observe, “the scope and approach of these IS Success evaluation studies has varied, and there is little consensus on the appropriate measures of IS Success” (2008, p. 378). The IS Success Model is subject to changes in the role computers play in corporations and to an increasing

range of circumstances to which it is being applied. (DeLone & McLean, 2002, p. 238) In the same way that DeLone and McLean first cautioned researchers to tailor success measures to the individual firm under investigation (1992, p. 88), the model as a whole needs the reflect the current state of both theory and practice.

The reference count of DeLone and McLean's model of IS success exceeds 1,000 publications (Petter & McLean, 2009, p. 159), which equals the number for the longer established TAM (Venkatesh et al., 2007, p. 768). As a consequence, "the DeLone and McLean (1992) IS Success model is most widely cited and has been a valuable contribution to our understanding of IS Success" (Gable et al., 2008, p. 379).

Researchers can tailor the model to fit their specific needs. They find the literature to contain a wealth of constructs in a variety of combinations, many of which have been empirically tested and validated. There is a stream of discussion surrounding ambiguous variables such as Use or Individual Impact. How to define these variables is subject to the specific circumstances under investigation, but there is evidence supporting either side of the argument. Petter and McLean count over 150 publications, which "have examined some or all of the relationships in the model" (2009, p. 159). When a few studies suffice to invalidate a model, this large number of publications indicates support for the model, albeit with some caveats.

The authors of the remaining 1,000 minus 150 publications have incorporated the IS Success Model in their academic work. This goes a long way in fulfilling DeLone and McLean's original hope for "creating the long-awaited 'cumulative tradition' in I/S" (DeLone & McLean, 1992, p. 88). While each author may have a unique and different perspective on his research object and on how best to apply the model, other authors are likely to be familiar with the underlying concepts. Thus, they can follow the reasoning and either agree or disagree with it. In either case, research will be conducted on common ground.

2.1.3.3 Applicability

Over the years, DeLone and McLean's model has been applied to various kinds of information systems, starting with Seddon and Kiew's (1994) investigation into the success of an Departmental Accounting System. McGill et al. (2003) looked at the success of user-developed spreadsheets. Bernroider (2008) adapted the model to the context ERP systems. Another application of the model is e-commerce systems. In 2001, Molla and Licker adapted DeLone and McLean's model with the purpose of "integrating the various independent variables into a comprehensive model and in [sic!] defining the dependent variable" (2001, p. 135). This again shows the potential of the model to serve as a blueprint to be adapted to specific circumstances. The work on e-commerce systems was continued by other authors, among them DeLone and McLean (2004a). Knowledge Management Systems (KMS) are another area of research which draws on DeLone and McLean's model of IS success (Kulkarni, Ravindran, & Freeze, 2007; Wu & Wang, 2006).

In summary, the IS Success Model has been tested empirically and has thus far not been found wrong. It provides researchers with a flexible yet consistent tool to determine the success of various kinds of information systems. As a result, researchers have made ample use of the model and created a large body of knowledge regarding both the model itself and the variables, which can be used within the model. All these characteristics make DeLone and McLean's model stand out as the model best suited to carry out the investigation purported in this dissertation.

Section 2.2 will look at the model in more detail and discuss its modifications, adaptations and empirical tests by other researchers. Subsequently, section 2.3 will describe the adaptations, modifications and definitions necessary in this dissertation in order to render the model applicable to determining the success of information systems at small and medium sized manufacturing firms in Germany. However, besides TAM and the IS Success Model, there are also other approaches to determine IS

success. The following sections will describe those approaches that would hold some promise of serving as the research model, but also discuss the reasons why they are not chosen.

2.1.4 Other Approaches

2.1.4.1 IS Effectiveness Matrix

In contrast to the focus on one success variable introduced by DeLone and McLean's model of IS success, the IS Effectiveness Matrix intends to capture the diversity of IS success measures for different stakeholders and systems. The framework was first presented by Seddon et al. at the ICIS in 1998 and published the following year in the Communications of the AIS (1999). The authors pursue two objectives, first "to debunk the idea" of a single instrument to measure IS success and second, "to emphasize the importance of identifying the context in which IS effectiveness is being evaluated" (Seddon et al., 1998, p. 174).

After much "reading of the literature", Seddon et al. (1998, p. 167) suggest a six-by-five matrix with six system types and five stakeholder groups. Next, they conduct a literature review and assign the success measures used in the various papers to points in the matrix. They included 186 empirical papers published between 1988 and 1996. Table 4 shows the matrix and the number of papers assigned to each combination of system and stakeholder.

The matrix was later employed by Seddon, Graeser and Willocks (2002) to evaluate the responses of 80 senior IT managers who were asked about their opinions on the effectiveness of their IT organisation. The authors intended "to update our understanding of the measures and practices used at the turn of the 21st century for organizational IS effectiveness measurement" (2002, p. 12). Due to the open answer format of the questions and the relatively low sample size, this study can clearly be identified as qualitative research. The IS Effectiveness Matrix provides a suitable framework to interpret the results. However, it is difficult to apply the matrix to quantitative research because it

bars any attempt of statistical modelling and analysis. It is therefore not suited as a research framework for this dissertation.

	An aspect of IT design or use	A single IT application	A type of IT or IT application	All IT applications used by an organisation	An aspect of a system development methodology	An IT function	Total measures for this type of stakeholder
Independent observer	21	5	12	1	8	1	**48**
Individual	10	11	25	3	11	10	**70**
Group	1		26		1		**28**
Management or owners	1	6	15	9	6	13	**50**
A country			2	2			**4**
Total measures for this type of system	**33**	**22**	**80**	**15**	**26**	**24**	**200**

Table 4: Frequency of occurrence of IS Effectiveness Measures for each different combination of system and stakeholder.
Adapted from Seddon et al., 1998, p. 173.

2.1.4.2 IS-Impact Measurement Model

What was later to be known as the IS-Impact Measurement Model started with an ICIS paper by Gable, Sedera and Chan in 2003. The authors recognised several shortcomings in IS success research and set out to develop and empirically test a model of ES (Enterprise System) success. They conducted two surveys, an exploratory one to develop their model and a confirmatory one to validate it. In both cases, they sent a questionnaire to

27 government agencies in Australia which had recently implemented SAP R/3. The a priori model contained five success measures adapted from DeLone and McLean (1992): System Quality, Information Quality, Satisfaction, Individual Impact and Organisational Impact. These constructs were supposed to load on a higher-level construct called “Enterprise Systems Success” (Gable et al., 2003, p. 582). The data from the second survey showed good model fit. All constructs loaded on ES Success, but Satisfaction was identified as a distinct measure of IS success. (Gable et al., 2003, pp. 583-586)

At the following ICIS, Sedera and Gable (2004) presented a revision of their model with a more rigid analysis of their structural equation model. They had conducted a third survey of the same government agencies “to further specify the a priori model based on constructs and measures deriving from the identification survey” (2004, p. 453). In addition, they also tested four other structural models, but concluded that the original model “explains the ESS phenomenon better than any of the other alternative models tested” (2004, p. 458).

The model was finally published in 2008 (Gable et al., 2008) and dubbed the IS-Impact Measurement Model. In addition to what had already been discussed in the ICIS papers, the final model shows IS impact in the context of the wider IT function with Satisfaction and Use as both antecedents and outcomes of IS impact. The full IS-Impact Measurement Model is shown in figure 7.

This model has the advantage of being very simple in nature and of having received empirical support. Even though it is an adaptation of the IS Success Model, it deviates substantially from it. Therefore it is not directly comparable to other studies based on DeLone and McLean’s model of IS success, which limits the possibility of interpreting it in a wider context. Furthermore, because the model ultimately aims at explaining Satisfaction / Use, it is difficult to include success measures for managerial accounting. The variable Impact has the same problems as will be discussed for DeLone and

McLean's original model in section 2.2. Thus, the IS Success Model remains the preferable basis for a research model in this dissertation.

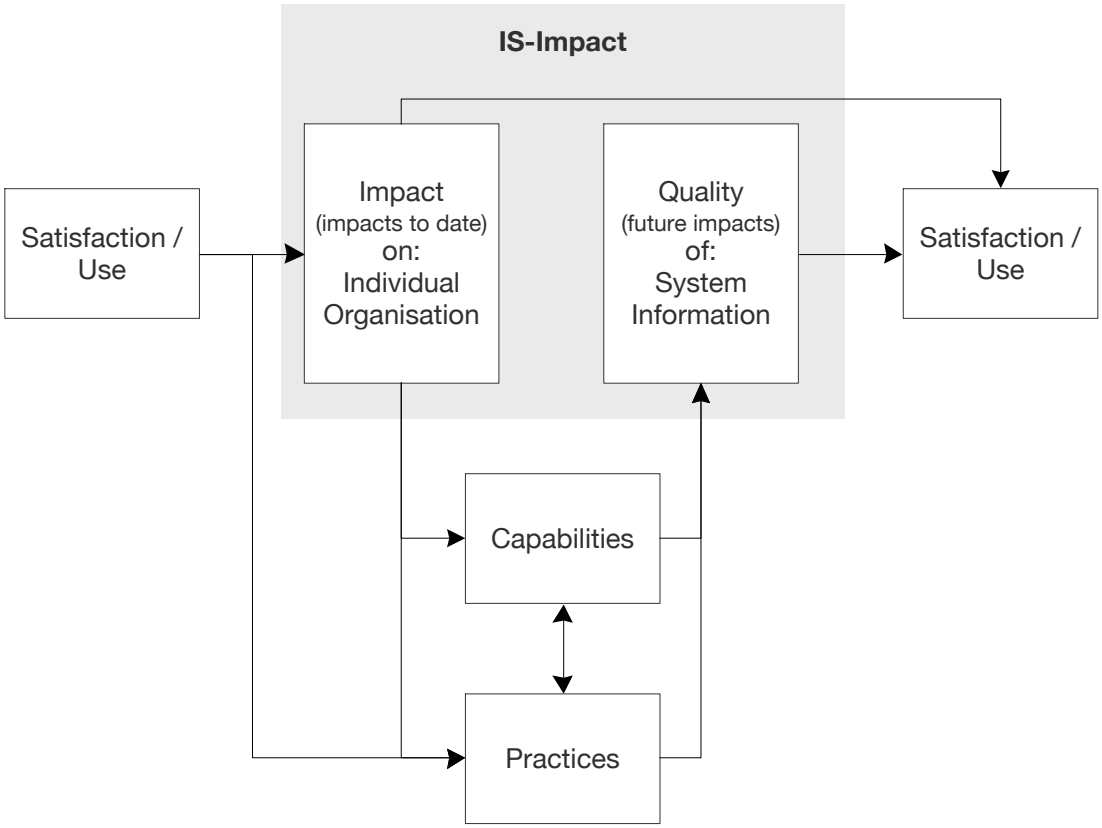


Figure 7: IS-Impact Measurement Model.
Adapted from Gable et al., 2008, p. 395.

2.1.4.3 Technology-to-Performance Chain

Goodhue and Thompson argue that for any positive impact to materialise from IS, "the technology must be utilized, and the technology must be a good fit with the tasks it supports" (Goodhue & Thompson, 1995, p. 213). In order to account for these requirements, they develop their Technology-to-Performance Chain as a combination of utilisation and task-technology-fit (TTF) theories (Goodhue & Thompson, 1995). In addition to building their theoretical model, they also tested a subset of that model empirically (see figure 8). The survey comprised over 600 people working for two different companies. Results, however, were mixed. One the one hand, the authors

found moderate support for the hypothesis that users' evaluations of TTF are determined by characteristics of both the system and the respective task. Moreover, both TTF and utilisation are required in order to predict performance. On the other hand, evidence was weak for the causal link between TTF and utilisation. (Goodhue & Thompson, 1995, p. 228)

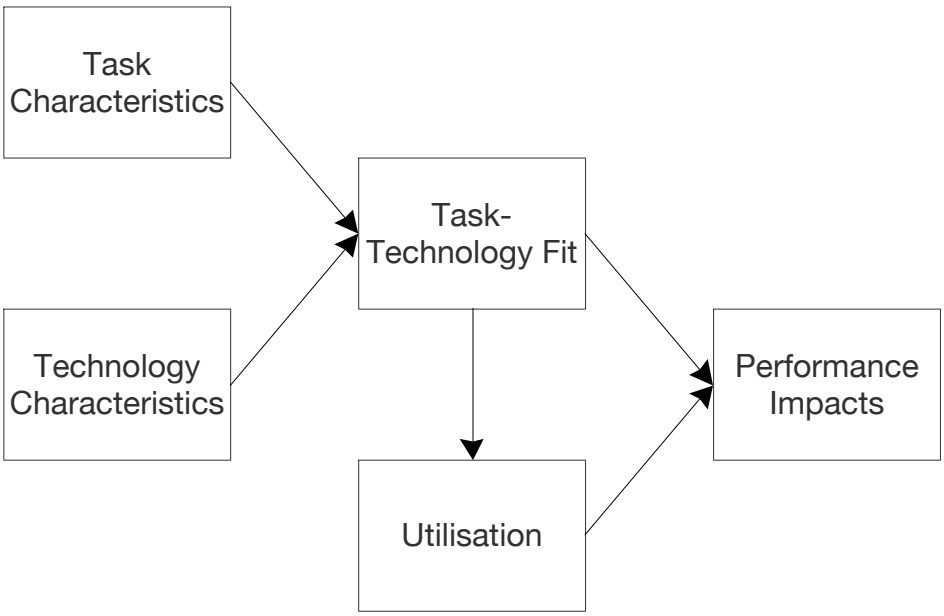


Figure 8: Technology-to-Performance Chain.
Adapted from Goodhue & Thompson, 1995, p. 220.

In a later article, Goodhue (1998) developed an instrument to measure the determinants of TTF. This is a useful extension to the technology-to-performance chain and emphasises the importance of TTF for evaluating IS success. Goodhue found that the "task-technology fit instrument has demonstrated strong reliability and strong discriminant validity for 12 separate dimensions of task-technology fit" (Goodhue, 1998, p. 125).

The technology-to-performance chain contributes to the understanding of IS success by taking into account users' evaluations of their systems and the changing role of technology. Goodhue points out that "when the instrument was designed, mainframes and networked PCs within an organization were the dominant technologies" (Goodhue, 1998, p. 127). Nevertheless, the model has two shortcomings which prevent its application in this

dissertation. First, it relies on utilisation, which cannot always be assumed as voluntary (see section 2.2). Second, there is little empirical support for the strength of the proposed relationships.

2.1.4.4 3-D Model of IS Success

The 3-D Model of IS Success by Ballantine et al. (1996) is an extension of DeLone and McLean's model of IS success in an attempt to alleviate some of its alleged weaknesses. The authors suggest three dimensions of IS success: Development, Deployment and Delivery, which are separated by filters that are connected by learning (see figure 9). The first level refers to the technical aspects of the system, the second to the interaction with the user and the third to business benefits. (Ballantine et al., 1996, pp. 10-13)

While the model certainly resolves some issues with the IS Success Model, it is more complex and not as readily put to a statistical test. One example for such an issue is the discepancy between a process or variance interpretation of the model. These and other issues will be discussed in section 2.2. Unfortunately, the authors of the 3-D Model of IS Success did not attempt to validate it empirically. It therefore remains an interesting, but speculative alternative to DeLone and McLean's model of IS success.

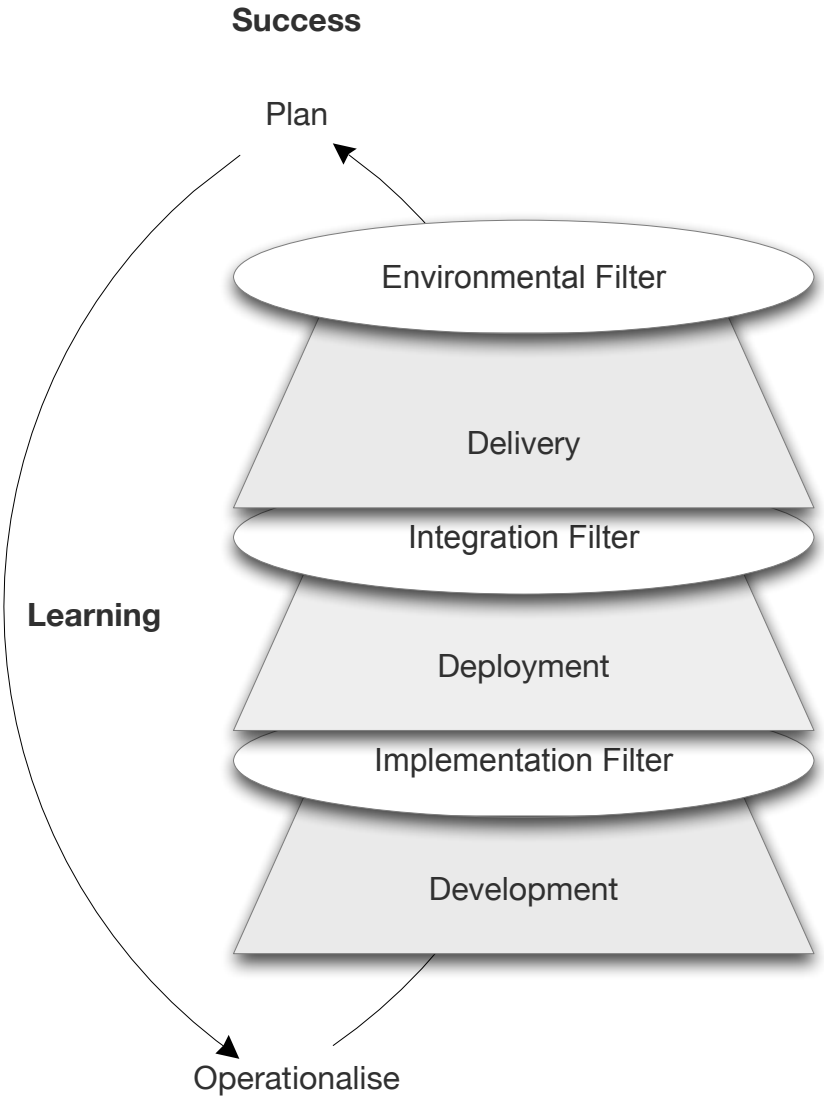


Figure 9: The 3-D Model of IS Success.
Adapted from Ballantine et al., 1996, p. 11.

2.1.4.5 Hierarchical Structural Model of IS Success

Drury and Farhoomand (1998) also seek to further develop the IS Success Model by introducing a Hierarchical Structural Model of IS Success. They view IS as a "process technology concerned with the utilisation of resources" (Drury & Farhoomand, 1998, p. 28). Based on this assumption, they develop a model comprised of five different factors contributing to system success (see figure 10). Next, they collected questionnaire answers from 382 firms. In their analysis, they differentiated between internal and external systems (i.e. systems which communicate with other systems outside the organisation). The model exhibited good fit to the data and the "tests provided sufficient

evidence that the basic structural model of IS success fits both classes of systems adequately" (Drury & Farhoomand, 1998, p. 33).

The hierarchical model described in figure 10 has the shortcoming of treating each hierarchy as a step in a process leading up to systems success. It is the same problem as with DeLone and McLean's model (see section 2.2), but aggravated because the authors view IS success as something akin the output of a production process. Furthermore, the model is too narrowly focused on technological factors to be suitable for this dissertation.

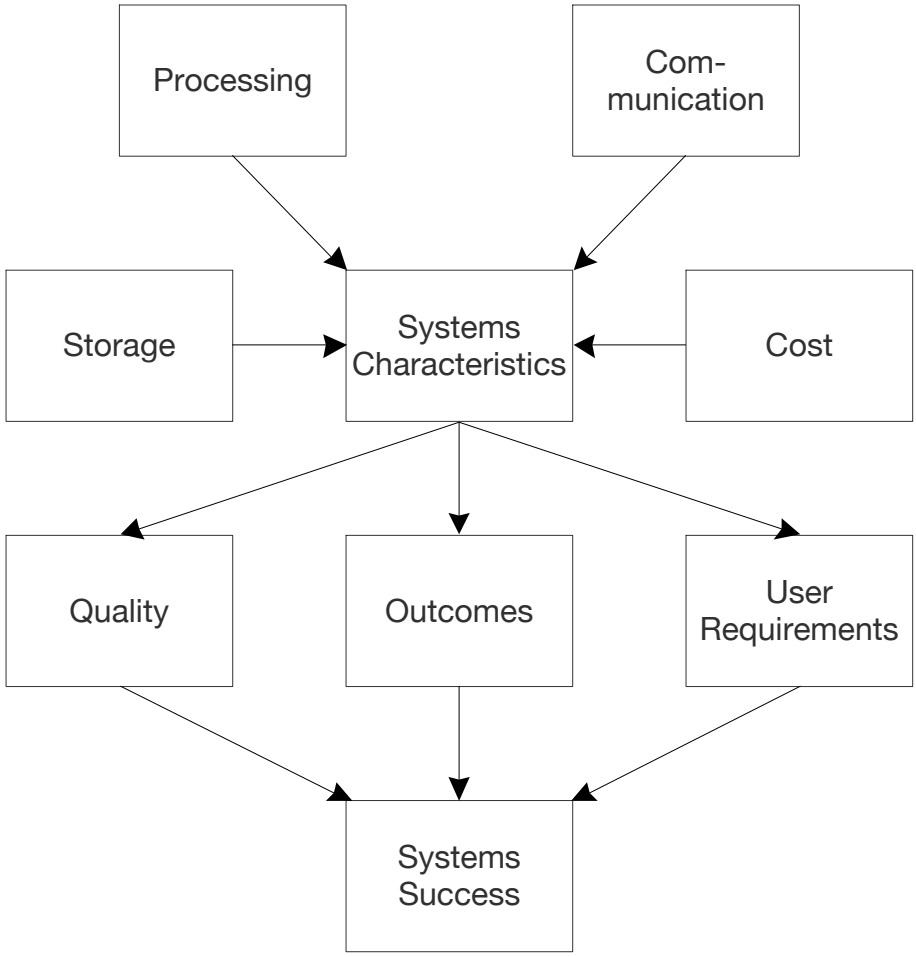


Figure 10: Hierarchical Structural Model of IS Success.
Adapted from Drury & Farhoomand, 1998, p. 29.

2.2 The IS Success Model in Detail

2.2.1 A Precursor: Computer-Based IS Success at Small Manufacturing Firms

Four years before the article on IS success co-authored by McLean, DeLone investigated the "factors associated with computer success in small firms" (1988). This study saw Use and Impact as indicators of computer-based information system (CBIS) success and tried to test their influence by investigating nine hypotheses, with a success factor underlying each. The sample consisted of 93 responses (48.7% response rate) from small manufacturing firms in Los Angeles. These firms had on average 62 employees, USD 5m in annual revenue and had been using computers for the past two years. (DeLone, 1988) Table 5 summarises the findings:

Factor	**Influence on CBIS Success**
External programming support	No relation found
CBIS planning	No relation found, except in the presence of use of computer controls
CEO knowledge of computers	Positive relation found
Top management involvement	Positive relation found
Personnel acceptance of computer systems	No relation found
Length of computer use	No relation found
Employee training	No relation found
On-site computing	Positive relation found

Table 5: Influencing factors of CBIS success.
Adapted from DeLone, 1988, pp. 54-58.

These findings emphasise the pivotal role played by the CEO and top management in general. DeLone states that "the primary finding of this study is that the chief executive is the key to the realization of that potential impact [i.e. potential impact of CBIS]" (DeLone, 1988, p. 57). The second supposed

dependent variable, Use, seems not to be affected by either employee acceptance or length of computer use. This clearly shows the distinction between TAM and the success branch of IS research. Moreover, it lends support to the 1992 DeLone and McLean model of IS success which suggests that Use is influenced only by System Quality, Information Quality and User Satisfaction.

While this study may be seen as just preliminary work in light of the later IS Success Model, it nevertheless has the benefit of an empirical foundation. This foundation is provided for the IS Success Model only in later years. In addition, it directly addresses the question of IS success at small firms and takes into account some of the unique restraints applying to this kind of business. (DeLone, 1988)

2.2.2 Modifications and Adaptations

In the wake of the original 1992 paper on IS success, many authors contributed to the model. Some have suggested modifying one or more variables while others have investigated adaptations of the model. In fact, this development was envisioned and intended by DeLone and McLean when they stated that their model "clearly needs further development and validation before it could serve as a basis for the selection of appropriate I/S measures" (1992, p. 88). The latter sentence has been the starting point for many authors to present their constructive criticism (e.g. Drury & Farhoomand, 1998; Seddon & Kiew, 1994; Wu & Wang, 2006).

The following sections discuss the major modifications and adaptations the IS Success Model has undergone so far.

2.2.2.1 The DeLone & McLean – Seddon Debate

One major stream of argument about the IS Success Model involves Peter Seddon and his co-authors on one side, and DeLone and McLean on the other. This debate is noteworthy for several reasons:

- It highlights the discrepancies between DeLone and McLean's theory-driven approach and Seddon's conclusions drawn from empirical validation.
- Seddon is among the first to test DeLone and McLean's model and thus proves influential for the further development of the model.
- The debate persists for almost 10 years and is recognised by all authors, unlike criticism published in any one individual paper.

Two years after DeLone and McLean's original paper, Seddon and Kiew (1994) presented some modifications and a first empirical test of the model. They first sought to more clearly express the idea behind the construct "Use". DeLone and McLean take "Use" to mean the voluntary use of an information system. As an IS success measure, this construct would measure behaviour as a proxy for success. Seddon and Kiew argue that this notion is better expressed by "Usefulness" because the prerequisites for voluntary use cannot always be met. They follow Davis' definition of perceived usefulness as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320).

Having thus modified the model, they argue that "User Satisfaction" is caused by "Usefulness" and not vice versa (as was the case with "Use"). In the absence of a statistical proof of causality, Seddon and Kiew resort to a semantic discussion of the underlying relationship between the two constructs. Ultimately, they conclude that "increases or decreases in Usefulness will lead to increases or decreases in User Satisfaction with information systems, but not vice versa (because some increases in Satisfaction are unrelated to Usefulness)" (Seddon & Kiew, 1994, p. 103).

They also introduce "User Involvement" as a new variable in order to explain the variance in Usefulness and User Satisfaction. User Involvement is thought to measure the degree to which the users' interests are reflected in the functionality of the information system. In addition to DeLone and McLean's technical evaluation of the system, Seddon and Kiew deem it

“essential to consider the individual interests of the people being asked to evaluate the information system” (Seddon & Kiew, 1994, p. 104).

Finally, they test the model, but exclude Individual Impact and Organisational Impact on account of the difficulty in measuring these variables. Their sample consists of 102 responses (out of 144) from users of the Department Accounting System, which had been newly implemented at their university. In summary, their results “provide considerable support for the DeLone and McLean model of IS success” (Seddon & Kiew, 1994, p. 105). However, the new variable User Involvement was found to only explain the variance in Usefulness, but not in User Satisfaction. In addition, Information Quality did not seem to impact Usefulness.

In 1997, Seddon builds on his previous study and suggests more far-reaching modifications to the IS Success Model. A major focus of his criticism is the combination of a process model and a variance model. In the first case, a change in one variable is necessary but not sufficient to change the outcome, whereas in the latter case each change in a variable is both necessary and sufficient to alter the outcome. (Seddon, 1997, p. 241) In addition to the methodological problems incurred, Seddon believes that the “result is a level of muddled thinking that is likely counter-productive for future IS research” (Seddon, 1997, p. 242).

He also extends the discussion about the precise meaning of the variable “Use”. According to Seddon (1997, pp. 242-243), possible interpretations include:

- “IS Use as a Variable that Proxies for the Benefits from Use. […]
- IS Use as the Dependent Variable in a Variance Model of Future IS Use. […]
- IS Use as an Event in a Process Leading to Individual or Organizational Impact.”

Seddon finds that only the first interpretation is valid. He continues to define the variable as Usefulness because “it is a potentially good proxy for the

benefits of IT use" (Seddon, 1997, p. 249). Moreover, he extends the model by a path that measures behaviour which is influenced by User Satisfaction and in turn impacts on the IS model as a whole (see figure 11). The resulting model comprises two variance models, i.e. one of partial behaviour and the IS Success Model itself. He also drops the variable User Involvement from the model. In addition, the causal direction between Net Benefits on the one side and Perceived Usefulness and User Satisfaction on the other side is inverted. Net Benefits now lead to Perceived Usefulness and User Satisfaction instead of the other way around. Seddon argues that "User Satisfaction and Perceived Usefulness are both likely semantically closer to the notion of Net Benefits than the other measures" (1997, p. 250). Thus, Perceived Usefulness and User Satisfaction become dependent variables in his model and the three instances of Net Benefits are treated as independent variables.

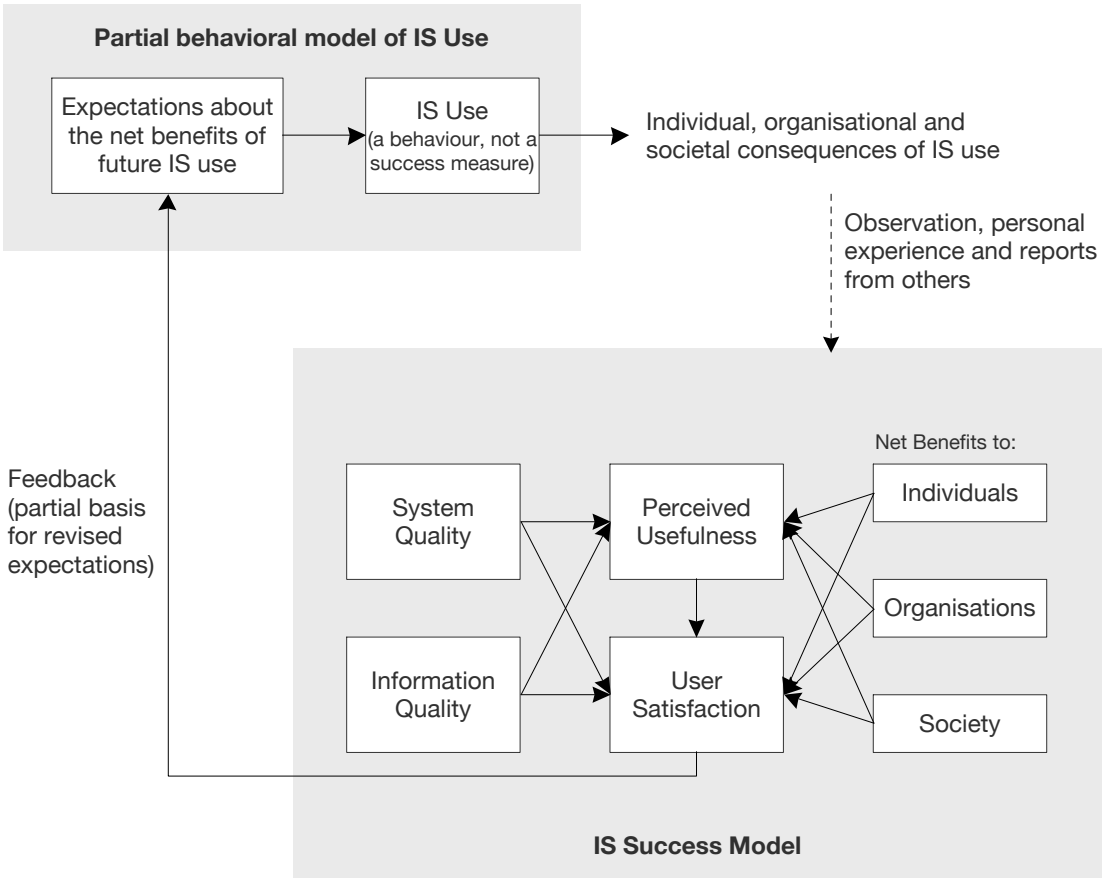


Figure 11: Seddon's modified IS Success Model.
Adapted from Seddon, 1997, p. 245.

The paper provides further justification for replacing Use with Usefulness and at the same time clarifies the conceptual meaning behind that variable. By moving the IS Success Model firmly into the realm of variance models, Seddon renders the model better suited for quantitative empirical testing. However, the considerable extensions introduced in the paper require researchers to focus on certain aspects of the model. For example, Rai, Lang and Welker (2002) have excluded the behavioural branch in their comparative analysis of DeLone and McLean's model and Seddon's model.

In 1998, Seddon, Staples, Patnayakuni and Bowtell suggested a different approach to measuring IS success. They "argue that because of the range of different systems, stakeholders, and issues involved in different studies, a wide diversity of sharply-focused dependent variables is essential" (1998, p. 165). This argument is presented in direct contrast to DeLone and McLean's approach of fitting measurements into their system of six categories. Alternatively, they suggest an IS Effectiveness Matrix (see section 2.1.4.1) which contains effectiveness measures for various stakeholders in the IS and various system characteristics. The authors reiterated their argument a year later in a paper published in the Communications of AIS citing 186 empirical articles in support of their matrix. (Seddon et al., 1999)

While the IS Effectiveness Matrix is certainly not an evolutionary outcome of DeLone and McLean's model of IS success, it challenges the original assumption that diversity in success measures needs to be confined to a largely standardised model. The modifications presented by Seddon and his co-authors over the years range from modest to comprehensive and even to revolutionary. Although they arrive at an approach quite distinct from DeLone and McLean's first incarnation, they have encouraged researchers to adopt a broader view of determining IS success.

In 2003, DeLone and McLean published their "10-year update" in which they summarise the contributions of other authors by either enhancing or testing the model. Their ideas were first presented the year before at the 35th Hawaii

International Conference on System Sciences (DeLone & McLean, 2002). Their updated model is shown in figure 12.

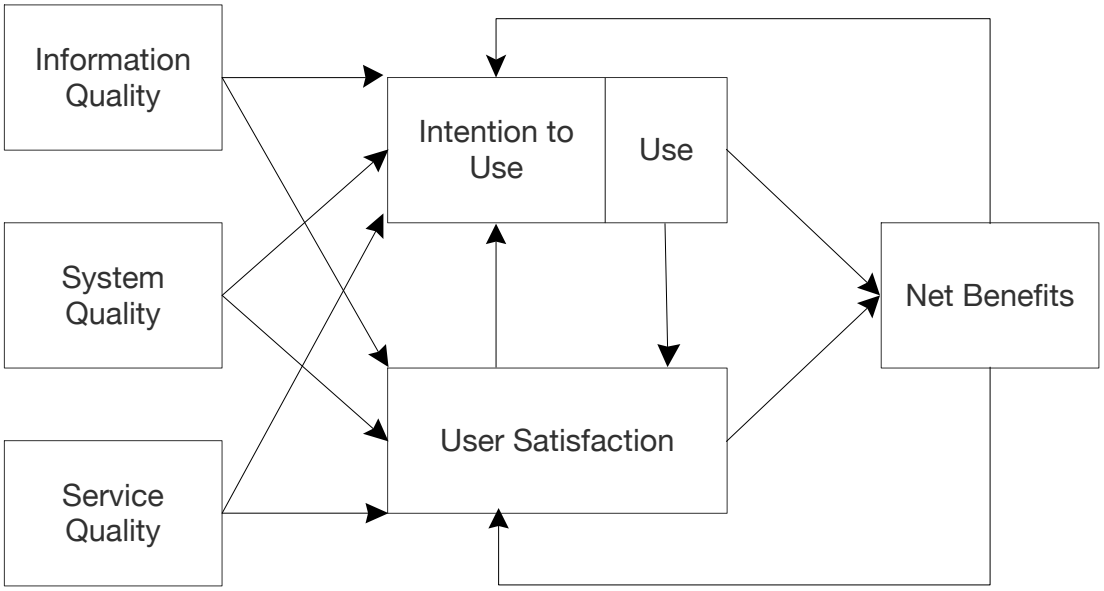


Figure 12: Updated IS Success Model.
Adapted from DeLone & McLean, 2003, p. 24.

They agree with Seddon's contention that a combined process and variance model is potentially confusing, but point out that the "reformulation of the D&M Model into two partial variance models […] unduly complicates the success model, defeating the intent of the original model" (DeLone & McLean, 2003, p. 16). The process view of the model stems from their understanding of the changes needed before any impact can be achieved.

With respect to Use versus Usefulness, DeLone and McLean find that Use is still a valid variable and holds a more complex meaning than Seddon assumed. They urge researchers to "consider the nature, extent, quality, and appropriateness of the system use" (DeLone & McLean, 2003, p. 16). However, given the aforementioned difficulties, they "suggest 'intention to use' may be a worthwhile alternative measure in some contexts" (DeLone & McLean, 2003, p. 23).

In light of the changes in IT over the decades from just providing information output to maintaining an infrastructure that is constantly accessed by end-

users, DeLone and McLean introduce “Service Quality” as a variable alongside Information Quality and System Quality. This variable is intended to measure the effectiveness of the IT organisation in providing their services to the end user. The decision was also made to list it as a variable in its own right rather than as a subset of System Quality in order to emphasise its emerging importance. (DeLone & McLean, 2003, p. 18)

Another adjustment of the model deals with Individual and Organisational Impact. DeLone and McLean now combine the two variables into “Net Benefits”. They argue that “the choice of where the impacts should be measured will depend on the system or systems being evaluated and their purposes” (DeLone & McLean, 2003, p. 19). This can be seen as a response to the difficulties in measuring an individual or even an organisational impact.

The debate has resulted in two major accomplishments: First, Use has become more clearly defined, be it as Usefulness or Use/Intention to Use. Second, the emphasis of the IS Success Model as a variance model has aided the evaluation of the model by statistical methods. In 2008, Petter, DeLone and McLean summarised the current state of the IS Success Model and the suggestions by Seddon and his co-authors form a vital part of that paper. (Petter, DeLone, & McLean, 2008)

2.2.2.2 Other Modifications

Table 6 lists some major modifications and adaptations of DeLone and McLean’s model of IS success. The list is not exhaustive but intends to highlight the direction into which the model has developed.

Source	Description
Pitt, Watson, & Kavan, 1995	Introducing Service Quality as a variable for the same reasons DeLone and McLeans include it in 2003.
Teo & Wong, 1998	Incorporating the variables “Intensity of IT Investment”, “Managerial Satisfaction” and “Improvements in Work Environment” in order to measure the impact of computerisation in the retail industry.
Garrity & Sanders, 1998	Expanding the model with the variables “Task Support Satisfaction”, “Quality of Worklife Satisfaction”, “Interface Satisfaction” and “Decision Making Satisfaction” in order to make the model congruent with general systems theory.
Ishman, 1998	Introducing “Group Impact” and distinguishing between the different levels within the model, the consequences for data collection and analysis.
Sipior, Ward, & Wagner, 1998	Discussing the ramifications of legal obligations for the measurement of IS success.
Myers, Kappelman, & Prybutok, 1997	Adding “Service Quality” and “Workgroup Impact” as a potential mediator between Individual and Organisational Impact in order to make the model more comprehensive.
Gable et al., 2003	Building and validating an ES success model which is partly based on the IS Success Model.
DeLone & McLean, 2004	Applying the revised IS Success Model to measuring the success of e-commerce systems.
Wu & Wang, 2006	Building on the revised IS Success Model. Measuring KMS success and therefore replacing Information Quality with “Knowledge/Information Quality”, Use with “Perceived KMS Benefits” and Net Benefits with “KMS Use”.

Source	Description
Kulkarni et al., 2007	Building and validating a KMS success model based on DeLone and McLean's model.
Bernroider, 2008	Adapting the revised IS Success Model to measure the influence of IT governance on the success of ERP projects. Introducing "Financial Benefits" alongside Net Benefits.
Wang, 2008	Adapting the revised IS Success Model to measure the success of e-commerce systems. Replacing the variable Net Benefits with "Intention to Reuse" and adding "Other Net Benefits".

Table 6: Other modifications to the IS Success Model.

2.2.3 Empirical Tests

DeLone and McLean's model of IS success has been used and tested numerous times. This section describes those empirical studies, which test the validity of the model itself.

2.2.3.1 Summarising Findings

The literature surrounding the IS Success Model in all its forms has become so vast that in 2009, Petter and McLean conducted a meta-analysis of the empirical support for the model. They counted "at least 150" papers which examined one or more of the hypotheses associated with the paths in the model. Findings on the support for the hypotheses have been mixed. (Petter & McLean, 2009, p. 159) The meta-analysis constitutes a more comprehensive approach than the 2008 literature review on the same topic (Petter et al., 2008). However, both papers concentrate on the revised model published in 2003.

The approach for identifying suitable papers for the meta-analysis is described by Petter and McLean (2009, pp. 161-162). A keyword-based search in various databases yielded up to 500 publications between the years 1992 and 2007 dealing with DeLone and McLean's model. Next, they

filtered the initial results and arrived at 52 studies, which fulfilled the criteria necessary for use in a meta-analysis.

Table 7 summarises the results for each hypothesis, listing the number of studies and the sample sizes alongside. Even though Service Quality had been added to the revised model six years earlier and had been discussed for much longer, hardly any study has investigated the paths associated with that variable. The effect of changes in Service Quality on the Intention to Use has not been examined at all. The hypotheses that changes in Service Quality have an effect on User Satisfaction and on Use could not be supported. The relationships underlying the last two hypotheses were also found to be not significant. (Petter & McLean, 2009, p. 164)

Many of the studies included in the meta-analysis have investigated the determinants of Net Benefits. Both User Satisfaction and Use were found to have a positive effect on Net Benefits. The first has a strong relationship; the latter has a relationship of moderate strength. The relationship between Use and User Satisfaction was investigated by almost half the studies. Among the supported hypotheses, this one is the only to exhibit weak strength. Inversely, the supported relationship between User Satisfaction and Intention to Use is the strongest of all.

The meta-analysis shows general support for DeLone and McLean's model of IS success with two exceptions: First, the variable Service Quality receives little attention in studies, and its effect on other constructs is rejected whenever investigated. The authors also mention this outcome, but give no explanation other than that the variable was a "recent addition" (Petter & McLean, 2009, pp. 163&165). Second, the findings show the ambivalent nature of the variables Use and Intention to Use.

Hypothesis	Studies	Sample Size	Result
System Quality and Intention to Use	12	2,864	Supported
System Quality and User Satisfaction	17	3,653	Supported
Information Quality and Intention to Use	5	1,312	Supported
Information Quality and User Satisfaction	10	2,136	Supported
Service Quality and Intention to Use			Not tested
Service Quality and User Satisfaction	3	366	Not Supported
Use and User Satisfaction	26	5,231	Supported
User Satisfaction and Intention to Use	9	2,245	Supported
Use and Net Benefits	26	4,416	Supported
User Satisfaction and Net Benefits	31	6,030	Supported
Net Benefits and Intention to Use	14	3,335	Supported
System Quality and Use	15	2,408	Supported
Information Quality and Use	7	897	Supported
Service Quality and Use	4	448	Not Supported

Table 7: Results of the meta-analysis of the IS Success Model.
Adapted from Petter & McLean, 2009, p. 163.

In their paper on the 10-year update of the model, DeLone and McLean (2003) cite 16 papers that had investigated the relationships in the original model. Except for one, all the studies included in the analysis support the IS Success Model. The strongest relationship was found between Use and Individual Impact. The second strongest was a direct relationship between System Quality and Individual Impact. (DeLone & McLean, 2003, pp. 13-15)

The general support for the paths in the IS Success Model is consistent over both the original and the revised model. Limitations to the support concern the variables Service Quality and Use / Intention to Use.

2.2.3.2 Selected Studies

While the previous section seeks to give a broad and summarising overview of the support for DeLone and McLean's model, this section intends to discuss the various aspects of the model in more detail. A complete literature review is outside the scope of this chapter and has already been accomplished by the papers cited in the preceding section. The following studies have been selected because they empirically test the model as a whole and report their statistical findings.

Rai et al. (2002) compare the validity of the DeLone and McLean's original model to the validity of Seddon's respecified model (Seddon, 1997). They collected data from 904 staff members of a "midwestern university" who used a student information system (SIS). The use of the system is described as quasi-voluntary. From the population of 904 they receive 274 useable responses. They find no evidence for non-response bias in their sample.

Gefen et al. suggest that the χ^2 statistic be as low as possible and that the ratio of χ^2 to the degrees of freedom should not exceed 3:1 (Gefen, Straub, & Boudreau, 2000, p. 35). The respective values are given in table 8. The authors also discuss other statistical tests in order to evaluate the models.

	DeLone and McLean	**Seddon**	**Seddon (Amended)**
χ^2	303.89	392.87	303.00
df	113	114	113
ratio	2.69	3.45	2.68

Table 8: Comparison of model fit for DeLone and McLean's and Seddon's model.
Adapted from Rai et al., 2002, p. 63.

While both models show good fit, DeLone and McLean's model exhibits better fit. Rai et al. assume that this is due to the omission of the path between User Satisfaction to Perceived Usefulness. The modification index prompts them to amend the model with the mediating variable "System

Dependence" between User Satisfaction and Perceived Usefulness. They suggest that "due to various factors, such as no ready access to the information through other means, SIS may be the users' only viable choice for accessing job-related information. Without viable alternative systems, perceived usefulness of SIS may not be assessed relative to competing information systems, but more in terms of the need for the information that SIS provides" (Rai et al., 2002, p. 62). As the newly introduced variable is correlational, rather than causal, Seddon's model still remains valid.

Seddon's amended model shows equally good fit as DeLone and McLean's original model. In light of this result, researchers need to pay close attention to whether or not the use of an IS is voluntary, not voluntary or something inbetween. If it is modelled to be one thing, but in reality is another, the items will no longer measure the construct they allegedly pertain to.

McGill, Hobbs and Klobas (2003) also tested the DeLone and McLean's original model for its applicability to user-developed applications (UDAs). Their sample consists of 79 MBA students with at least two years of work experience. They participated in a business simulation game in which they find it useful to develop a spreadsheet in order to manage their simulated manufacturing firm. (McGill et al., 2003, pp. 29-30)

The authors slightly adapted the model to account for the special nature of user-developed application (McGill et al., 2003, pp. 27-28):

- System Quality was split into two variables: Perceived System Quality and (Objective) System Quality, where the latter precedes the first.
- Information Quality is explained as Perceived Information Quality.
- Intended Use replaced Use in order to only capture time spent using the system and not time spent developing the system.
- User Satisfaction is modelled to influence Intended Use and not vice-versa.

The resulting model showed acceptable fit with a ratio of χ^2 to the degrees of freedom of 1.73. However, only four paths were found to be significant. They

include the respective effect of Perceived System Quality and Perceived Information Quality on User Satisfaction as well as the effect of User Satisfaction on both Intended Use and Perceived Individual Impact.

The path from (Objective) System Quality to Perceived Quality was found to be not significant. Intended Use is solely explained by User Satisfaction. Any Organisational Impact was not significantly influenced by any Perceived Individual Impact. They did not report, however, whether or not a path from Intended Use to User Satisfaction would have increased model fit.

In summary, the study found support for the importance of user perceptions in evaluating the success of UDAs. This result may be particular to this type of application (McGill et al., 2003, p. 41), but it is certainly instructive when trying to understand the meaning of the various variables and their relationships.

Iivari (2005) sets out to test the IS Success Model. His sample consists of 75 users of the financial and accounting system at Oulu City Council. Users were mandated to use the system. The model to be tested is close to DeLone and McLean's original model, with Use defined as Actual Use and the omission of Organisational Impact. Due to the theorised mutual influence of Actual Use and User Satisfaction, two alternative models were developed: one with Actual Use influencing User Satisfaction, one the other way around. (Iivari, 2005, pp. 14-15)

Unfortunately, no fit statistics are reported. But both models yield similar results. All hypotheses were supported in the respective models, except for two: Perceived Information Quality does not predict Actual Use and Actual Use does not predict Individual Impact. The two paths between Actual Use and User Satisfaction are both supported, but neither explains much variance. User Satisfaction does in fact explain more variance in Actual Use than vice versa. (Iivari, 2005, pp. 16-18)

The individual studies yield more differentiated results than the summarising findings by Petter and McLean (2009). The model is generally supported and

exhibits acceptable fit to the different data sets. User Satisfaction emerges as an important predictor of either Use or Perceived Usefulness. Information and System Quality impact primarily on User Satisfaction and not on Use or Perceived Usefulness. User Satisfaction mainly determines Net Benefits. In the original model, Individual Impact could not be found to predict Organisational Impact. The decision between Use and Perceived Usefulness is not just a conceptual question but also a matter of whether users work in a voluntary environment or not.

2.3 The IS Success Model as the Research Model

2.3.1 Net Benefits for SMEs

2.3.1.1 Defining Net Benefits

Net Benefits measure whether having the information system is worthwhile or not. Because DeLone and McLean's model deliberately includes several success dimensions, Net Benefits cannot be seen as the ultimate measure of IS success. While other dimensions of an information system may be successful, Net Benefits denotes the value added to the firm.

Originally, the variable was divided into Individual Impact and Organisational Impact. DeLone and McLean recognise that the sole focus on these two variables neglects any impact that might be felt at any unit of analysis in between. Therefore, in their revised model, they "group all the 'impact' measures into a single impact or benefit category called 'net benefits'" (DeLone & McLean, 2003, p. 19). At the same time, they pose three questions which the researcher has to answer in order to "specify the focus of analysis" (DeLone & McLean, 2003, p. 23):

- What constitutes a benefit under the specific circumstances?
- To whom do the benefits occur?
- What is the level of analysis?

The answers to the last two questions are derived from the purpose of the study undertaken in this dissertation. The objective is to investigate the factors contributing to an information system's success at enabling managerial accounting at manufacturing SMEs. One key characteristic of SMEs is the lack of a specialised or highly departmentalised administrative structure. Consequently, employees have to take on several different tasks. (Nooteboom, 1988, pp. 302-303) Moreover, another characteristic is their heavy reliance on the owner-manager. (IfM, 2007, pp. 5-6) A study by Ibrahim and Goodwin (1987) ranked "Entrepreneurial Values" and "Managerial Skills" as the number one and two factors contributing to small business success. With respect to managerial accounting, Lohr (2012) found support for both of these characteristics among German SMEs in the industrial sector. His study shows that managerial accounting is performed not only by specialised managerial accountants, but also by the managing director and other administrative staff. Therefore, the level of analysis is the administrative branch of the firm. Benefits are to occur to those conducting managerial accounting, which is mainly the managing director and a few other staff members.

The answer to the question of what constitutes a benefit has to take into account two aspects: First, benefits must be pertinent to resource poverty at SMEs and second, they must fall within the realm of managerial accounting. Only those benefits are valid success measures, which satisfy both conditions (see figure 13).

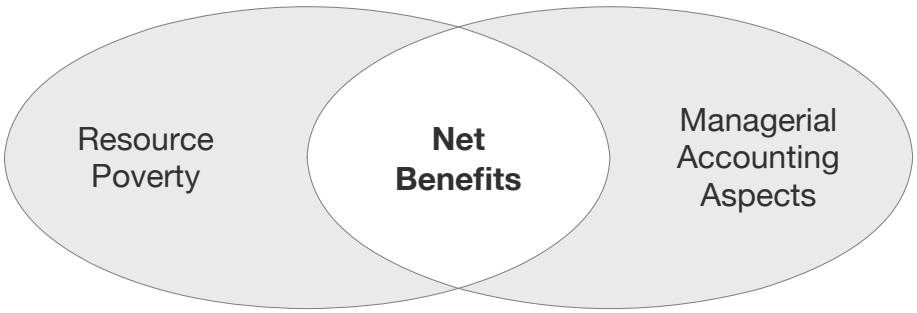


Figure 13: Intersection of Net Benefits.

SMEs are a distinct category of companies as described in section 1.3.3. Therefore, certain Net Benefits have special significance for them. The way to establish these specific benefits is to look both at the challenges facing SMEs and also at the factors, which lead some SMEs to become commercially successful. The challenges are summarised by Welsh and White's (1981) notion of "resource poverty". The various aspects of resource poverty are described by Soh, Ya and Raman as "severe constraints on financial resources, a lack of trained personnel, and a short-range management perspective imposed by a volatile competitive environment" (1992, p. 310).

A study by Kim, Knotts and Jones (2008) investigates the factors contributing to the survival and success of small manufacturing firms. Their data set consists of 1,690 companies which participated in the survey. Using the Adaptive Learning Approach (ALN), they identified six factors (in descending order of importance) which explained the survival of some firms and the failure of others: company orientation, price determination, production experience, product lifecycle, quality control and cash flow. They conclude that "while a long-term survival is not the only measure of the success of a small manufacturing firm, survived firms encompass other well-known success measures such as sales performance and profitability" (Kim et al., 2008, p. 132).

Ibrahim and Goodwin (1987) conduct explorative quantiative research in order to identify factors contributing to small business success. Their sample consists of 74 participating firms in the original study and 70 in their replication study. A factor analysis of the data yields four factors in descending order of importance: entrepreneurial values, managerial skills, interpersonal skills and environmental characteristics. These findings complement those by Kim et al.

Any relevant benefit has to satisfy the following two criteria:

1. It has to alleviate a characteristic of resource poverty.
2. Its power to alleviate resource poverty has to stem from conducting managerial accounting.

As a check on the semantic validity of the benefits, they should also pertain to a success factor for SMEs. Table 9 aggregates all these criteria and names the benefits which are discussed in more detail in subequent sections.

Characteristic of Resource Poverty	**Managerial Accounting Aspect**	**Success Factor**	**Net Benefit**
Financial constraints	Cost accounting Budgeting	Price determination Cash flow	**Cost Savings**
Lack of trained personnel	Support and complementary function	Interpersonal skills	**Better Cooperation**
Volatile environment	Forward-looking budgeting Balanced Scorecard	Clear company orientation Environmental characteristics	**Reduced Uncertainty**

Table 9: Net Benefits for SMEs.

Having established potential benefits for SMEs, the managerial accounting perspective has to be taken into account, as well. As described in section 1.3.2, managerial accounting consists of three functions: the support function, the complementary function and the limitation function. Each function has to be fulfilled at different organisational levels. Managerial accounting instruments facilitate the functions under different organisational settings. The resulting model of managerial accounting by Lohr (2012, pp. 36-41) can be used to filter the variety of potential SME benefits.

The following sections deal with three Net Benefits, which are derived from the preceding discussion and answer the question of what constitutes a benefit for those SMEs conducting managerial accounting.

2.3.1.2 Cost Savings

Constrained financial resources are an important characteristic of resource poverty for SMEs (Soh et al., 1992, p. 318; Welsh & White, 1981, p. 12). Krämer (2003, pp. 86-91) emphasises the same point in the context of German SMEs. He argues that SMEs have a low equity-to-debt ratio due to the German laws of incorporation, which limit their ability to inject new equity. Furthermore, debt financing is favoured by the German tax code as interest payment can be expensed against the tax burden. However, in the absence of sufficient equity financing and with a lack of collaterals, interest rates for German SMEs are comparatively high.

Cost accounting provides the means to accurately determine a product's cost and its contributing factors. Transparency and an understanding of the interdependencies of costs are the purpose of cost accounting. This is an important prerequisite for effectively reducing costs and thus making better use of the available capital. (Berry, Broadbent, & Otley, 2005, pp. 101-106; Krämmler-Burrak, Sasse, & Hofmann, 2006, pp. 94-95; Weber, 2004, pp. 191-193)

Budgeting is the process of expressing strategic goals in monetary terms. When financial resources are limited, they must be allocated prudently onto the firm's various strategic goals. If the company fails to do so, it will waste resources on less important goals and at the same time risk failing to achieve its most important goals. (Anthony & Govindarajan, 2007, pp. 6-7; Horngren, 2004, pp. 209-2010; Plümecke, 2006, pp. 10-14; Rickards, 2006, p. 62)

When done correctly, cost accounting and budgeting can help utilising the available financial resources to the best degree possible. While these are well-established aspects of managerial accounting, they do not exhaust all the possible contributions managerial accounting can make towards dealing

with constrained financial resources. However, they congrue with two success factors discussed earlier: In order to be successful at the level of price determination, the actual costs must be known. A company's cash flow can also be optimised when the budget is prudent and sound.

All these aspects result in the Net Benefit "Cost Savings". It describes the degree to which the information system enables the employees to improve organisational efficiency culminating in monetary savings above and beyond the monetary cost of operating the system.

2.3.1.3 Better Cooperation

A lack of trained personnel is another characteristic of resource poverty (Soh et al., 1992, p. 318; Welsh & White, 1981, p. 12). Here, Krämer (2003, pp. 95-98) states that personnal is key to the success of German SMEs. However, SMEs experience restrictions in terms of working conditions, hiring of qualified staff, salaries and training. Division of labour is less pronounced than at large corporations and employees often have to take on tasks from several different areas of work. As a consequence, employees become experts for their activities and fail to share their knowledge with their colleagues.

The concept of managerial accounting adopted in this dissertation explicitly demands cooperation through the support function or the complementary function. (Manegold et al., 2007, pp. 23-25; Weber & Schäffer, 1999; Weber, Schäffer, & Prenzler, 2001, pp. 35-139) On the one hand, this means cooperation between managerial accountants and managers to improve their basis for decision-making; on the other hand, this means cooperation among employees generally in order to establish and maintain managerial accounting instruments and procedures.

A lack of qualified personnel requires every employee to take on more responsibilities. The success of the company depends on the ability of the employees to improve the efficiency of managerial accounting by cooperating effectively. Kosmider (1991, pp. 188-190) and Lohr (2012) found

that managerial accounting at SMEs is often conducted by the managing director, the commercial director or some other employee who is not a specialised managerial accountant. Especially when managerial accounting is part of the job description of many employees, the need for cooperation becomes even stronger. Cooperation is an intangible objective, but can materialise itself in the success factor of interpersonal skills.

The resulting Net Benefit is “Better Cooperation”. It describes the degree to which the information system enables the employees to improve their work efficiency by taking advantage of each other’s unique abilities.

2.3.1.4 Reduced Uncertainty

A volatile environment is a third characterstic of resource poverty for SMEs. (Soh et al., 1992, p. 318; Welsh & White, 1981, p. 12) Krämer (2003, pp. 19-20) argues that manufacturing SMEs struggle to realise economies of scale. When initially incurring high fixed costs, the success of the firm depends on high output or high margins. Furthermore, some SMEs are suppliers to a large corporation, which becomes their major customer. If they loose this customer, their entire business is at jeopardy. (Krämer, 2003, p. 51) Volatility also plays a part in exchange rates. When exporting their goods abroad, manufacturing SMEs are exposed to this risk. (Krämer, 2003, p. 44)

Managerial accounting can reduce environmental uncertainty by using forward-looking budgeting instruments, such as Better Budgeting (Neely, Bourne, & Adams, 2003, pp. 23-25; Plümecke, 2006, pp. 50-57; Rickards, 2006, pp. 69-70). These instruments do not simply extrapolate last year’s budget to the next, but attempt to base forecasts on projections of the company’s future environment. A rolling forecast is a means of ensuring that the budget always contains current and realistic figures.

Another way to approach environmental uncertainty is to formulate well-balanced strategic goals which reflect that uncertainty. The Balance Scorecard (BSC) (Butler, Letza, & Neale, 1997, pp. 242-244; Kaplan & Norton, 1993, pp. 134-135; Kaplan & Norton, 1996a, pp. 24-25; Kaplan &

Norton, 1996b) as a managerial accounting instrument encompasses several different perspectives. While the company has to choose their most important strategic persectives, they may include financials, customers, internal business and innovation/learning (Kaplan & Norton, 2005, p. 174).

Widening the setting and evaluating of strategic goals extends the company's awareness of uncertainties. That knowledge can then be used to adjust forward-looking budgets. Thus the company can monitor changes in its environment and translate new information into concrete action. Kosmider (1991, pp. 18-21) also discusses a model of reducing uncertainty. However, that model encompasses risk factors which do not stem from resource poverty, such as company size, technology or ecology. It is therefore not immediately pertinent to this Net Benefit, but illustrates the same point in a larger context. Successfully dealing with uncertainty also plays towards the two success factors of a better company orientation and a greater awareness of environmental characteristics.

The resulting Net Benefit is "Reduced Uncertainty". It describes the degree to which the information system enables the employees to improve the match of their predictions about the future and the actual unfolding of events.

2.3.2 The Advantages of Perceived Usefulness over Use

2.3.2.1 The Many Forms of Use

Use as an IS success variable was originally described by DeLone and McLean as "Recipient Consumption of the Output of an Information System" (1992, p. 66). Behind this intuitive yet vague definition lies the problem of reliably measuring Use. Researchers have resorted to many different measurements, both for conceptual and for practical reasons. In the build-up to their original model, DeLone and McLean list 27 studies, each of which tackled Use in a different way. Diversity has increased further since then. This section discusses the most common forms of Use.

One basic condition for the measurement of Use is that usage of the information system is voluntary. (DeLone & McLean, 1992, p. 68) Otherwise the logical assumption would not hold that increased usage is an indicator of increased success. However, the distinction between voluntary and non-voluntary Use is not black and white. As Rai et al. point out “even if use is not mandated, social pressure may compel system use” (2002, p. 54).

Actual Use is seen as an objective measure of system utilisation. It refers to the hours that a user spends with the information system. These hours are either measured externally or by monitoring the user’s activities via software. Alternative units of Actual Use can be the number of data requests or the number of any other discrete event in the execution of the system.

Ginzberg (1981) makes use of a number of measurements of Actual Use. He used data from the trust department of a large bank, which was operating an online portfolio management system (OLPM). In order to identify sources of MIS implementation failure, he measured usage of the system by capitalising on the fact that “a variety of such data are routinely collected by the system software” (Ginzberg, 1981, p. 468). His measurements of Actual Use included time (“Average number of minutes per month of on-line use of OLPM”) as well as frequency (“Average number of OLPM terminal sessions per month” and “Average number of OLPM functions executed per month”) (Ginzberg, 1981, p. 467).

Self-Reported Use is a variant of Actual Use. It shares the intention to measure usage in units of time or frequency. However, unlike Actual Use, Self-Reported Use relies on the user to give an accurate documentation of his usage of the system. Typically, the user is asked to assess and rate his usage in a questionnaire.

For their investigation into the effectiveness and determinants of DSS, Snitkin and King (1986) decided the measure usage of the system. In their study, “the level of system usage was assessed in terms of the estimated hours of use each week” (Snitkin & King, 1986, p. 84). When empirically testing the IS

Success Model, Iivari measured Use as Self-Reported Use in hours “How much time do you spend with the system during an ordinary day when you use computers?” and frequency “How often on average do you use the system?” (Iivari, 2005, p. 24). Both studies show the shortcomings of this method which needs to “estimate” usage on “an ordinary day”.

Intended Use compunds the problem as it is a user’s estimate of how long or how often he will use the system in the future. This measurement asks for hours and other units, but actually only receives an informed guess. Notwithstanding, DeLone and McLean introduced this form of Use alongside Actual Use in their revised model in order to alleviate the problem of variance versus causal model interpretation. They acknowledge that Intended Use is an attitude unlike Actual or Self-Reported use, which is a behaviour (DeLone & McLean, 2003, p. 23).

McGill et al. choose to include Intended Use instead of Actual Use in their study “because of concerns that perceptions of current use might include time spent iteratively developing the systems, intended use was considered more appropriate” (2003, p. 32). They subsequently ask participants the following question in their questionnaire: “Overall, how would you rate your intended use of the system over the next year of the BPG? (rarely....often)” (McGill et al., 2003, p. 42)

2.3.2.2 What is Perceived Usefulness?

Seddon has introduced the variable Perceived Usefulness in his revision of DeLone and McLean’s model and defines it as follows: “Perceived Usefulness is a perceptual indicator of the degree to which a stakeholder believes that using a particular system has enhanced his or her job performance, or his or her group’s or organization’s performance. A system is useful if [it] produces benefits. In judgements about Perceived Usefulness costs are much less important than benefits, so Perceived Usefulness is not the same concept as Net Benefits.” (Seddon, 1997, p. 246)

The definition is derived from Davis' (1989) paper in which he empirically supported the TAM. In the adapted version, Seddon identifies Perceived Usefulness as an attitude which reflects upon a past experience with the system. It makes no predictions about the future but rather evaluates users' current perceptions of the information system. The measurement of this variable can happen irrespectively of whether or not the usage of the system is voluntary.

Rai et al. closely follow Seddon's definition in their empirical testing of his model. They use a seven-point Likert-scale to measure this variable. The questions asked in the questionnaire include "Using SIS in my job increases my productivity" and "Using SIS enhances my effectiveness on the job" (Rai et al., 2002, p. 58).

2.3.2.3 For a Few Hours More

The relationship hypothesised by Use is that every change in usage is indicative of a change in IS success. Or, in a Baysian interpretation, that the likelihood of system usage increases with IS success. There are several objections to this hypothesis.

- As Gelderman points out, the relationship may lack sensitivity and "usage measurement will only identify the very unsuccessful systems" (1998, p. 12).
- As Seddon and Kiew point out, non-usage is not indicative of failure; "it may simply mean that there are other more pressing things to be done" (1994, pp. 100-101).
- As Rai et al. point out "even if use is not mandated, social pressure may compel system use" (2002, p. 54).

Besides these technical objections, using a system for longer hours is per se not necessarily a good thing. Why should a system be more successful just because the user spends more time in front of it? Even if system use is completely voluntary, it would be better if the user could accomplish the task quickly. Longer usage or more data requests might simply be an indication

that the system is difficult to use or fails to deliver just the information the user needs. Especially in the case of managerial accounting, where an analysis has to result in concrete action, less time spent with the system means more time to take action. An information system needs to be at the user's disposal, not constitute his primary occupation.

By contrast, Perceived Usefulness aims at measuring how good the system is at supporting the user in his work. Support for certain tasks can be really useful, even if it takes only a few seconds to complete them. Furthermore, the user gets to judge whether or not the information system is useful. He is in the best position to do so and an abstract number of daily usage cannot come close to the informational value of his assessment.

For all of these reasons, this dissertation will include Perceived Usefulness in the research model. Small and medium sized enterprises already suffer from resource poverty. Any additional hour spent with an information system is an hour that has to be justified for not being spent on some other activity. Perceived Usefulness, however, measures how well the information system helps alleviate the problems of resource poverty. It is therefore the more appropriate variable to be used in this study.

The decision to replace Use with Perceived Usefulness necessitates examining the relationship to Satisfaction. When they first introduced Perceived Usefulness as a variable in their modified IS Success Model, Seddon and Kiew (1994) attempted to determine the direction of the relationship semantically, but it is not possible to do so statistically. They concluded that "increases or decreases in Usefulness will lead to increases or decreases in User Satisfaction with information systems, but not vice versa (because some increases in Satisfaction are unrelated to Usefulness)" (Seddon & Kiew, 1994, p. 103). Rai et al.'s (2002) analysis found the path between Perceived Usefulness and Satisfaction to be significant at the 99% confidence level with a path coefficient of 0.26. This means that in their model, an increase in Perceived Usefulness will lead to a notable increase in Satisfaction. However, the results from the modification index analysis

prompted them to amend the model with a path leading from Satisfaction to System Dependence (their version of Use) and on to Perceived Usefulness. The amended model showed greater fit with the data, but the authors caution that “the significance of the path between two constructs may be a product of chance variation in the data rather than a reflection of an underlying structural relationship” (Rai et al., 2002, p. 62). This dissertation will follow Seddon and Kiew’s rationale, which was not contradicted by Rai et al.’s study, and will assume a unidirectional relationship from Perceived Usefulness to Satisfaction.

2.3.3 Antecedents to Information Quality and System Quality

The two variables Information Quality and System Quality are themselves determined by various antecedents. In fact, they are constructs originally derived from factors contributing to User Satisfaction. DeLone and McLean’s model of IS success has introduced Information Quality and System Quality as aggregates for the numerous measures of computer user satisfaction in earlier publications. (DeLone & McLean, 1992, pp. 64-66)

In 1983, Bailey and Pearson conducted a literature review in order to identify factors of computer user satisfaction. The review included 22 studies which yielded a total of 36 factors. These were then compared to the factors derived from interviews conducted with 32 middle managers across 8 organisations. In the end they arrived at a “reliable and valid measurement instrument” (Bailey & Pearson, 1983, p. 537).

Ives, Olson and Baroudi (1983) confirm the usefulness of Bailey and Pearson’s list of factors. They review four different measurement models of user satisfaction and compared both the underlying research method and the empirical support. At the time of the comparison, they conclude that Bailey and Pearson’s measurement instrument has the strongest empirical support of all competing instruments and the highest potential for being applied to a number of areas. (Ives et al., 1983, pp. 787-788)

Bailey and Pearson's work was later cited and used by several other authors, including DeLone and McLean (1992) and Seddon and Kiew (1994). Iivari (2005, p. 14) also draws on Bailey and Pearson's list for empirically testing the IS Success Model. He selects completeness, precision, accuracy, reliability, currency and format as antecedents to Information Quality, as well as flexibility, integration, response time, error recovery, convenience of access and language as antecedents to System Quality.

In a separate study, Nelson, Todd and Wixom (2005) specifically investigate the antecedents of Information Quality and System Quality. They discuss at length various possible antecedents to the two variables and finally include four antecedents to Information Quality and five antecedents to System Quality. The definition of these variables is listed in table 10 and adapted from Nelson et al.

In their study, the authors use structural equation modelling as a method to test the effect of these antecedents on the variables Information Quality and System Quality. Data was gathered via a questionnaire from 465 users of data warehousing systems across seven organisations. The resulting measurement model was found to satisfy reliability criteria. It furthermore exhibits strong convergent and discriminant validity, i.e. all antecedents can be assigned to a variable and the assignment is not ambiguous. (Nelson et al., 2005, pp. 209&213-214)

The research model will include Nelson et al.'s set of antecedents. Their effect has been empirically validated. Furthermore, they are congruent with the antecedents used in other studies which build on DeLone and McLean's model of IS success. Thus the results of this disseration can later be compared to the results of later studies with greater ease.

Success Measure	Antecedent	Definition
Information Quality	Accuracy	The degree to which information is correct, unambiguous, meaningful, believable, and consistent.
	Completeness	The degree to which all possible states relevant to the user population are represented in the stored information.
	Currency	The degree to which information is up-to-date, or the degree to which the information precisely reflects the current state of the world that it represents.
	Format	The degree to which information is presented in a manner that is understandable and interpretable to the user and thus aids in the completion of a task.
System Quality	Accessibility	The degree to which a system and the information it contains can be accesses with relatively low effort.
	Reliability	The degree to which a system is dependable (e.g., technically available) over time.
	Response Time	The degree to which a system offers quick (or timely) responses to requests for information or action.
	Flexibility	The degree to which a system can adapt to a variety of user needs and to changing conditions.
	Integration	The degree to which a system facilitates the combination of information from various sources to support business decisions.

Table 10: Antecedents to Information Quality and System Quality.
Adapted from Nelson et al., 2005, pp. 204&206.

2.3.4 The Complete Research Model

2.3.4.1 Structural Model

Figure 14 shows the aggregated research model based on the discussion of the various components in this chapter. The model consists of three strata, which when combined depict the complete research model:

1. The antecedents to Information Quality and System Quality
2. The adapted model of IS success by DeLone and McLean
3. The Net Benefits relevant to managerial accounting at SMEs

The variable Service Quality has not been included for lack of empirical evidence that it has an impact beyond what it is already captured by the variable System Quality. Section 2.2.3 discusses the empirical support for the variables derived from DeLone and McLean's model of IS success.

2.3.4.2 Latent Variables

Exogenous latent variables are constructs which are explained entirely by manifest (i.e. observed) variables. Endogenous variables, on the other hand, are at least partially explained by other latent variables. Due to their dependence on potentially insufficiently measured variables, endogenous latent variables have an error term attached to them. In the research model, the antecedents to Information Quality and System Quality are exogenous, all other variables are endogenous. All relationships between constructs are reflective. A change in one construct is not formative for a change in another construct, but that change is reflected in the other construct.

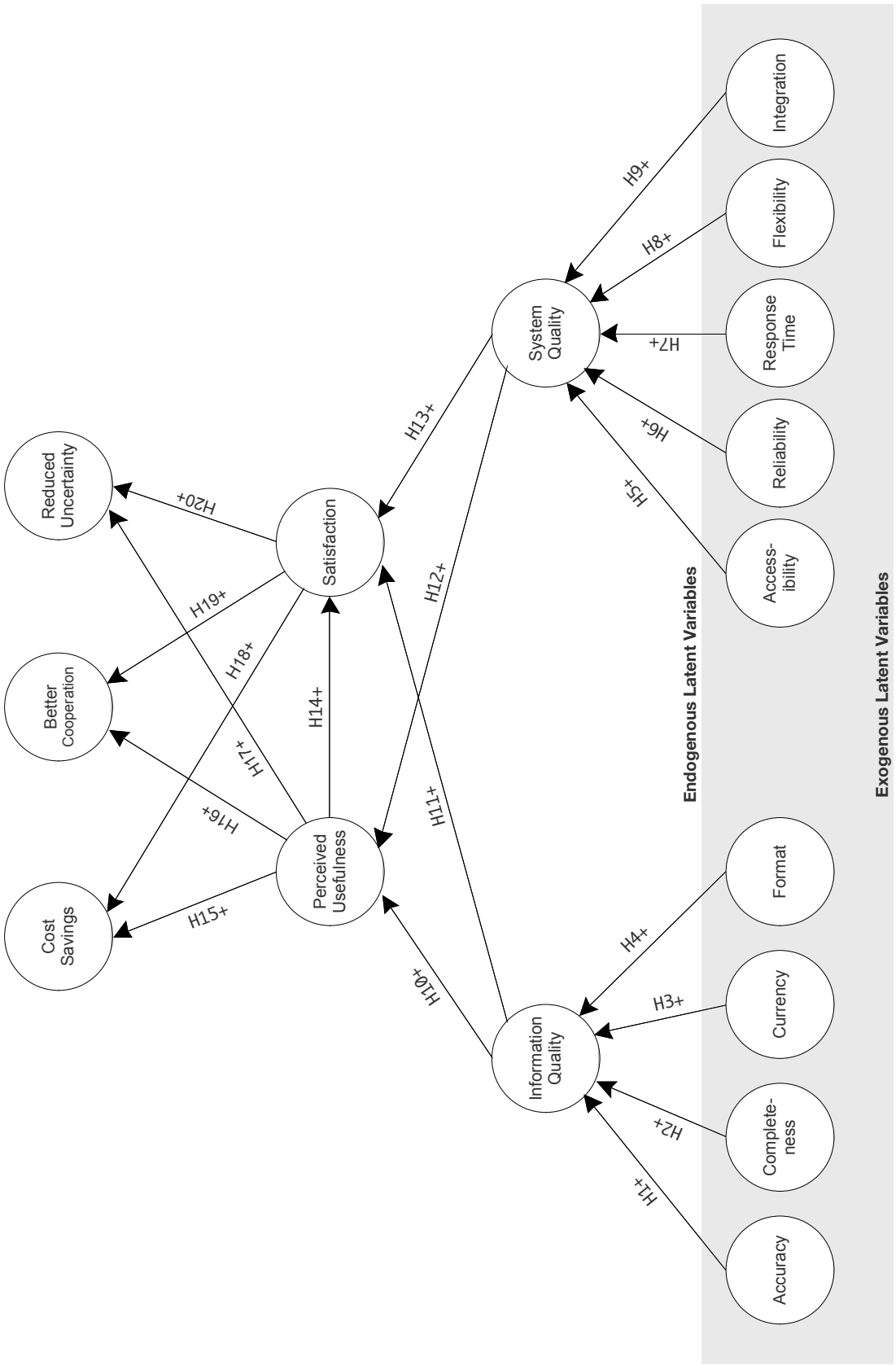


Figure 14: The complete research model.

2.3.4.3 Hypotheses

Each line in figure 14 denotes a hypothesised causal relationship with the arrowheads pointing from cause to effect. The relationships show a pattern of joint variance, rather than a process. DeLone and McLean attempt to integrate both perspectives into one model, because in addition to variance, some variables also share a common sequence. This dissertation does not investigate whether any variable precedes another, but what influence the change in one variable has on another variable, both of which are presumed to be causally related.

Any increase in Accuracy, Completeness, Currency or Format of an Information System will increase the Information Quality of that system. Similarly, any increase in Accessibility, Reliability, Response Time, Flexibility or Integration will increase System Quality. Any increase in either Information Quality or System Quality will lead to an increase in Perceived Usefulness and Satisfaction. Moreover, an increase in Perceived Usefulness will also increase Satisfaction. When either Perceived Usefulness or Satisfaction increases, this will lead to an increase in Cost Savings, Reduced Uncertainty or Better Cooperation.

This dissertation will empirically investigate the strength and significance of these relationships in the context of SMEs which use an information system to improve their ability to conduct managerial accounting. The following chapter transforms this research model into a structural equation model ready for empirical testing.

H	Latent Variable	Predictor	Assumed correlation
1	Information Quality	Accuracy	Positive
2	Information Quality	Completeness	Positive
3	Information Quality	Currency	Positive
4	Information Quality	Format	Positive
5	System Quality	Accessibility	Positive
6	System Quality	Reliability	Positive
7	System Quality	Response Time	Positive
8	System Quality	Flexibility	Positive
9	System Quality	Integration	Positive
10	Perceived Usefulness	Information Quality	Positive
11	Satisfaction	Information Quality	Positive
12	Perceived Usefulness	System Quality	Positive
13	Satisfaction	System Quality	Positive
14	Satisfaction	Perceived Usefulness	Positive
15	Cost Savings	Perceived Usefulness	Positive
16	Cost Savings	Satisfaction	Positive
17	Better Cooperation	Perceived Usefulness	Positive
18	Better Cooperation	Satisfaction	Positive
19	Reduced Uncertainty	Perceived Usefulness	Positive
20	Reduced Uncertainty	Satisfaction	Positive

Table 11: Research hypotheses.

3 The Research Design

The research design provides the means of obtaining the data to test the theoretical model developed in the previous chapter. The importance of a good research design is emphasised by Lucas (1989, p. 8) in his examination of survey research in information systems: “The research design is crucial in determining the credibility of a study. […] Design includes determining how to measure variables in the model, that is, the researcher operationalizes the variables.”

Operationalisation of variables into items is a major part of this chapter. However, the definition of items is preceded by a discussion of why structural equation modelling is the suitable statistical method for evaluating the research model. This chapter will also address the question of an appropriate answer scale.

The design of the survey will have a great impact on people’s willingness to participate and on the quality of the resulting data. Therefore, this chapter will explain all the considerations made to ensure the best possible design for the survey.

Finally, the chapter will report the various practical steps taken to carry out the survey. This includes pretesting, a description of the sample and the actual administration of the survey.

3.1 Why Structural Equation Modelling?

3.1.1 Applicability

Chapter 2 concludes with a list of 20 hypotheses to be tested in the research model. The relationships underlying the hypotheses are all between latent variables. Therefore, testing the hypotheses requires a second-generation data analysis technique. (Hoyle, 1995, p. 1) Structural equation modelling

(SEM) is such a technique and “enables researchers to answer a set of interrelated research questions in a single, systematic, and comprehensive analysis” (Gefen et al., 2000, p. 3).

For the present case, second-generation data analysis techniques have several advantages over first-generation techniques, such as linear regression. Goldenberger (1973, p. 2) argues that “in a structural equation model each equation represents a causal link rather than a mere empirical association. In a regression model, on the other hand, each equation represents the conditional mean of a dependent variable as a function of explanatory variables. It is this distinction that makes conventional regression analysis an inadequate tool for estimating structural equation models.” Jöreskog and Sörbom (1982, p. 404) emphasise the same point: “The structural equation model is used to specify the phenomenon under study in terms of tentative cause and effect variables and various causal effects.”

Besides these differences in applicability, second-generation techniques also have another advantage: They allow for simultaneously evaluating the structural model and the measurement model. This answers two questions respectively: Does the data support the hypotheses? Does the data adequately describe the latent variables? With first-generation techniques, this would require two separate analyses. (Anderson & Gerbing, 1988, pp. 411-412; Gefen et al., 2000, p. 5)

3.1.2 Inferring Causation

Figure 14 already represents a first step in developing a structural model. Each path in the model denotes a causal link which needs to be verified statistically. As explained by Bentler (1980, pp. 425-426), “causation implies correlation – but a very specific form. If the hypothesized causal process is correct, only certain values will be observed for these variances and covariances [between MVs and LVs]”. Hence the statistical evaluation of the model will indicate whether or not the model has to be rejected.

If the model is rejected, the data does not provide evidence for the hypothesised causal relationship. However, if the model is not rejected, it simply means that the data does not disprove the hypothesised causal relationship. (Cliff, 1983, pp. 116-117) Bullock, Harlow and Mulaik (1994) have devoted an entire article to the "Causation Issues in Structural Equation Modeling Research". In a reversal of Bentler's argument, their article revolves around the simple notion that "correlation does not imply causation" (1994, p. 253). However, in order to make valid statements about SEMs, they develop several criteria (1994, p. 264):

1. "Assess the relevance of and control for as many background conditions as possible.
2. Strive for longitudinal SEM designs to help assess the direction of causality.
3. Carefully operationalize latent variables.
4. Use four or more high-quality indicators per latent variable when it is appropriate.
5. Compare alternative models for a set of data.
6. Keep post hoc adjustments to a minimum.
7. Replicate and cross-validate all findings.
8. View each SEM study as just one part of a larger program of research to help understand a phenomenon."

With regard to using SEM in MIS research, Chin and Todd (Chin & Todd, 1995, pp. 238-239) have developed a similar list of four crucial points, of which many publications typically fall short: "inappropriate cross validation", "item and construct confound", "likelihood of capitalization on chance" and "lack of substantive knowledge and theoretical justification".

Hoyle and Panter (1995, p. 175) regard the statistical correlation in a SEM as "necessary but not sufficient evidence of causal relations". However, "if the research methods and design that generated the data favor a causal inference, then such an inference can be made". Thus, if the model has not

been rejected based on the data, the validity of the inferences depends on the correctness of the underlying theory.

3.1.3 LISREL

There are several types of structural equation modelling, which fall into two broad categories: covariance based and partial least square (PLS) based. The differences lie in the statistical method for estimating parameters and thus in the underlying assumptions about the model and the data. As a consequence, the two categories also differ in their applicability to various research questions. Covariance based SEM requires a sound theoretical underpinning of the model and makes certain assumptions about the distribution of the data. It is therefore only applicable to confirmatory SEM, i.e. testing against the null-hypothesis that a specified model is incorrect. PLS, which makes fewer assumptions about the model and the data, can be used for both confirmatory and exploratory SEM (i.e. deriving a model from data). (Bentler & Dudgeon, 1996; Fornell & Bookstein, 1982; Gefen et al., 2000, p. 27)

LISREL (Linear Structural Relations) is a covariance-based SEM technique first suggested by Jöreskog (1973). The acronym refers to the statistical method itself as well as to a computer application under the same name. It has received attention amongst scholars and can address some of the problems related to SEM in general, such as measurement errors, interdependence and missing variables. (Jöreskog & Sörbom, 1982, p. 404; Mueller, 1996, pp. vii-xii) Table 12 contrasts LISREL and PLS.

Even though LISREL and PLS are feasible alternatives, there are some methodological differences. When using LISREL, the parameters reflect the covariances between constructs. By contrast, PLS attempts to predict the variance in constructs. Thus, LISREL is better suited in the presence of a sound theoretical base and PLS is better suited for developing such a theoretical base. (Fornell & Bookstein, 1982, pp. 459-451) The confirmatory nature of the investigation in this dissertation favours the use of LISREL.

Provided that the data obtained from the survey satisfies the underlying requirements, LISREL will be used to evaluate the research model.

	LISREL	PLS
Objective of overall analysis	Show that the null hypothesis of the entire proposed model is plausible, while rejecting path-specific null hypotheses of no effect.	Reject a set of path-specific null hypotheses of no effect.
Objective of variance analysis	Overall model fit, such as insignificant $\chi 2$ or high AGFI.	Variance explanation (high R-square)
Required theory base	Requires sound theory base. Supports confirmatory research.	Does not necessarily require sound theory base. Supports both exploratory and confirmatory research.
Assumed distribution	Multivariate normal, if estimation is through ML. Deviations from multivariate normal are supported with other estimation techniques.	Relatively robust to deviations from a multivariate distribution.
Required Minimal Sample Size	At least 100-150 cases.	At least 10 times the number of items in the most complex construct.

Table 12: Comparison of LISREL and PLS.
Adapted from Gefen et al., 2000, p. 9.

3.2 Defining Items

3.2.1 General Information

As the heading suggests, this category is intended to gather general information about the participant and the company. Care was taken not to ask questions that might reveal the participant's identity. For example, the

combination of a certain number of employees, a particular industry and a zip-code might be sufficient to deduce the company.

Item	Wording	Source
GI1	English: What is your zip-code? German: Wie lautet Ihre Postleitzahl?	Own creation
GI2	English: What was your revenue in 2011? German: Wie hoch war Ihr Umsatz in 2011?	
GI3	English: What industry are you (mainly) in? German: Welcher Branche ordnen Sie sich (hauptsächlich) zu?	
GI4	English: What is your position in the company? German: Welche Stellung nehmen Sie im Unternehmen ein?	
GI5	English: If you wish, you can enter your email address below in order to later receive information about the results. German: Wenn Sie möchten, können Sie unten Ihre E-Mail Adresse angeben, um später über die Ergebnisse der Umfrage informiert zu werden.	
GI6	English: How many employees does your company have? German: Wieviele Mitarbeiter beschäftigt Ihr Unternehmen?	
GI7	English: What year was your company founded? German: In welchem Jahr wurde Ihr Unternehmen gegründet?	
GI8	English: Does your company use such an information system (IS)? German: Setzt Ihr Unternehmen so ein Informationssystem (IS) ein?	

Table 13: General information items.

The purpose of the general information is to obtain contingency factors that might aid in evaluating the data. This is particularly important when it comes to non-response bias.

3.2.2 Antecedents

This category refers to the antecedents of Information Quality and System Quality as discussed in the previous chapter.

3.2.2.1 Accuracy

Table 14 lists the four items pertaining to the latent variable Accuracy. Item Acc4 is not adapted from literature but an own creation in order to complement the other three items.

Item	Wording	Sources
Acc1	English: The IS produces correct information. German: Das IS bringt korrekte Informationen hervor.	Chen, 2010; Heidmann, Schäffer, & Strahringer, 2008; Hsiu-Fen & Gwo-Guang, 2006; McKinney, Kanghyun, & Zahedi, 2002; Nelson et al., 2005; Saeed & Abdinnour-Helm, 2008; Wixom & Todd, 2005
Acc2	English: There are few errors in the information I obtain from the IS. German: Die Informationen aus dem IS enthalten wenig Fehler.	
Acc3	English: The information provided by the IS is accurate. German: Die Informationen aus dem IS sind zutreffend.	
Acc4	English: I can rely on the information provided by the IS. German: Ich verlasse mich auf die Informationen aus dem IS.	Own creation

Table 14: Items pertaining to Accuracy.

3.2.2.2 Completeness

Table 15 lists the four items pertaining to the latent variable Completeness. Item Comp4 is not adapted from literature but an own creation in order to complement the other three items.

Item	Wording	Sources
Comp1	English: The IS provides me with a complete set of information. German: Das IS stattet mich mit vollständigen Informationen aus	Chen, 2010; Hsiu-Fen & Gwo-Guang, 2006; McKinney et al., 2002; Nelson et al., 2005; Wixom & Todd, 2005
Comp2	English: The IS produces comprehensive information. German: Das IS bringt umfassende Informationen hervor.	
Comp3	English: The IS provides me with all the information I need. German: Das IS liefert alle von mir benötigten Informationen.	
Comp4	English: There are no gaps in the information. German: Die Informationen aus dem IS enthalten keine Lücken.	Own creation

Table 15: Items pertaining to Completeness.

3.2.2.3 Currency

Table 16 lists the four items pertaining to the latent variable Currency. Item Curr4 is not adapted from literature but an own creation in order to complement the other three items.

Item	Wording	Sources
Curr1	English: The IS provides me with the most recent information. German: Das IS stattet mich mit den neuesten Informationen aus.	Hsiu-Fen & Gwo-Guang, 2006; Nelson et al., 2005; Wixom & Todd, 2005
Curr2	English: The IS produces the most current information. German: Das IS bringt die aktuellsten Informationen hervor.	
Curr3	English: The information from the IS is always up to date. German: Die Informationen aus dem IS sind immer aktuell.	
Curr4	English: The IS always provides the latest information. German: Das IS liefert immer die neuesten Informationen.	Own creation

Table 16: Items pertaining to Currency.

3.2.2.4 Format

Table 17 lists the four items pertaining to the latent variable Format. Item Form4 is not adapted from literature but an own creation in order to complement the other three items.

Item	Wording	Sources
Form1	English: The information provided by the IS is well formatted. German: Die Informationen aus dem IS sind gut formatiert.	Nelson et al., 2005; Saeed & Abdinnour-Helm, 2008; Wixom & Todd, 2005
Form2	English: The information provided by the IS is well laid out. German: Die Informationen aus dem IS werden gut dargestellt.	
Form3	English: The information provided by the IS is clearly presented on the screen.	

Item	Wording	Sources
	German: Die Informationen aus dem IS werden klar und deutlich auf dem Bildschirm angezeigt.	
Form4	English: The information's formatting is confusing. German: Die Formatierung der Informationen erschwert deren Verständnis.	Own creation

Table 17: Items pertaining to Format.

3.2.2.5 Accessibility

Table 18 lists the four items pertaining to the latent variable Accessibility. Item Access4 is not adapted from literature but an own creation in order to complement the other three items.

Item	Wording	Sources
Access1	English: The IS allows information to be readily accessible to me. German: Das IS gewährt mir schnellen Zugriff auf seine Daten.	Chen, 2010; Heidmann et al., 2008; Hsiu-Fen & Gwo-Guang, 2006; Nelson et al., 2005; Wixom & Todd, 2005
Access2	English: The IS makes information very accessible. German: Das IS macht Informationen gut zugänglich.	
Access3	English: The IS makes information easy to access. German: Es kann leicht auf Informationen im IS zugegriffen werden.	
Access4	English: Access to the information in the IS is straight-forward. German: Zugriff auf die Informationen im IS ist einfach.	Own creation

Table 18: Items pertaining to Accessibility.

3.2.2.6 Reliability

Table 19 lists the four items pertaining to the latent variable Reliability. Item Rel4 is not adapted from literature but an own creation in order to complement the other three items.

Item	Wording	Sources
Rel1	English: The IS operates reliably. German: Das IS arbeitet zuverlässig.	Hsiu-Fen & Gwo-Guang, 2006; Nelson et al., 2005; Wixom & Todd, 2005
Rel2	English: The IS performs reliably. German: Die Leistung des IS ist zuverlässig.	
Rel3	English: The operation of the IS is reliable. German: Der Betrieb des IS ist zuverlässig.	
Rel4	English: I can depend on the performance of the IS. German: Ich kann mich auf die Leistungsfähigkeit des IS verlassen.	Own creation

Table 19: Items pertaining to Reliability.

3.2.2.7 Response Time

Table 20 lists the four items pertaining to the latent variable Response Time. Item Resp4 is not adapted from literature but an own creation in order to complement the other three items.

Item	Wording	Sources
Resp1	English: It takes too long for the IS to respond to my requests. German: Es dauert zu lang, bis das IS auf meine Abfragen reagiert.	McKinney et al., 2002; Nelson et al., 2005; Wixom & Todd, 2005
Resp2	English: The IS provides information in a timely fashion. German: Das IS liefert Informationen zeitnah.	

Item	Wording	Sources
Resp3	English: The IS returns answers to my requests quickly. German: Das IS gibt schnell Antworten auf meine Abfragen zurück.	
Resp4	English: The IS responds to my requests instantly. German: Das IS antwortet sofort auf meine Abfragen.	Own creation

Table 20: Items pertaining to Response Time.

3.2.2.8 Flexibility

Table 21 lists the four items pertaining to the latent variable Flexibility. Item Flex4 is not adapted from literature but an own creation in order to complement the other three items.

Item	Wording	Sources
Flex1	English: The IS can be adapted to meet a variety of needs. German: Das IS kann auf vielfältige Bedarfe angepasst werden.	Hsiu-Fen & Gwo-Guang, 2006; Nelson et al., 2005; Wixom & Todd, 2005
Flex2	English: The IS can flexibly adjust to new demands or conditions. German: Das IS kann sich flexibel auf neue Anforderungen oder Bedingungen anpassen.	
Flex3	English: The IS is versatile in addressing needs as they arise. German: Das IS kann vielseitig auf neu entstehende Bedürfnisse eingehen.	
Flex4	English: The IS is limited to a specific set of functions. German: Das IS ist auf einen bestimmten Funktionsumfang begrenzt.	Own creation

Table 21: Items pertaining to Flexibility.

3.2.2.9 Integration

Table 22 lists the four items pertaining to the latent variable Integration. Item Int4 is not adapted from literature but an own creation in order to complement the other three items.

Item	Wording	Sources
Int1	English: The IS effectively integrates data from different areas of the company. German: Das IS integriert wirkungsvoll Daten aus verschiedenen Unternehmensbereichen.	Heidmann et al., 2008; Nelson et al., 2005; Saeed & Abdinnour-Helm, 2008; Wixom & Todd, 2005
Int2	English: The IS pulls together information that used to come from different places in the company. German: Das IS führt Informationen zusammen, die ansonsten aus verschiedenen Unterenehmensbereichen kommen.	
Int3	English: The IS effectively combines data from different areas of the company. German: Das IS kombiniert wirkungsvoll Daten aus verschiedenen Unternehmensbereichen.	
Int4	English: Overall, the IS is well integrated with other systems in the company. German: Insgesamt ist das IS gut mit anderen Systemen im Unternehmen integriert.	Own creation

Table 22: Items pertaining to Integration.

3.2.3 DeLone & McLean Variables

This category refers to the variables adapted from DeLone and McLean's model of IS success as discussed in the previous chapter.

3.2.3.1 Information Quality

Table 23 lists the four items pertaining to the latent variable Information Quality. Item Info4 is not adapted from literature but an own creation in order to complement the other three items.

Item	Wording	Sources
Info1	English: Overall, I would give the information from the IS high marks. German: Insgesamt würde ich den Informationen aus dem IS gute Noten geben.	Nelson et al., 2005; Wixom & Todd, 2005
Info2	English: Overall, I would give the information provided by the IS a high rating in terms of quality. German: Insgesamt würde ich die Qualität der Informationen aus dem IS hoch bewerten.	
Info3	English: In general, the IS provides me with high-quality information. German: Allgemein stattet mich das IS mit qualitativ hochwertigen Informationen aus.	
Info4	English: The information provided by the IS is exactly what I want. German: Das IS liefert die Informationen genau so, wie ich sie möchte.	Own creation

Table 23: Items pertaining to Information Quality.

3.2.3.2 System Quality

Table 24 lists the four items pertaining to the latent variable System Quality. Item Sys4 is not adapted from literature but an own creation in order to complement the other three items.

Item	Wording	Sources
Sys1	English: In terms of system quality, I would rate the IS highly. German: Im Hinblick auf die Systemqualität würde das IS hoch bewerten.	Nelson et al., 2005; Wixom & Todd, 2005
Sys2	English: Overall, the IS is of high quality. German: Insgesamt ist das IS von hoher Qualität.	
Sys3	English: Overall, I would give the quality of the IS a high rating. German: Ingesamt würde ich die Qualität des IS hoch bewerten.	
Sys4	English: The IS operates the way I expect it to. German: Das IS läuft gemäß meinen Erwartungen.	Own creation

Table 24: Items pertaining to System Quality.

3.2.3.3 Perceived Usefulness

Table 25 lists the six items pertaining to the latent variable Perceived Usefulness. All items are adapted from Seddon and Kiew (1994), whereas items Use2, Use3, Use4 and Use6 also correspond to items used by Saeed and Abdinnour-Helm (2008).

Item	Wording	Sources
Use1	English: Using the IS in my job enables me to accomplish my tasks more quickly. German: Durch den Einsatz des IS bei meiner Arbeit bin ich in der Lage, meine Aufgaben schneller zu bewältigen.	Adams, Nelson, & Todd, 1992; Davis, 1989; Saeed & Abdinnour-Helm, 2008; Seddon & Kiew, 1994; Wixom & Todd, 2005
Use2	English: Using the IS improves my job performance. German: Der Einsatz des IS verbessert meine Arbeitsleistung.	

Item	Wording	Sources
Use3	English: Using the IS in my job increases my productivity. German: Der Einsatz des IS bei meiner Arbeit erhöht meine Produktivität.	
Use4	English: Using the IS enhances my effectiveness in the job. German: Der Einsatz des IS steigert meine Arbeitseffektivität.	
Use5	English: Using the IS makes it easier to do my job. German: Der Einsatz des IS macht es leichter, meine Arbeit zu erledigen.	
Use6	English: Overall, I find the IS useful to my job. German: Ingesamt finde ich das IS nützlich für meine Arbeit.	

Table 25: Items pertaining to Perceived Usefulness.

3.2.3.4 Satisfaction

Table 26 lists the four items pertaining to the latent variable Satisfaction. All items are adapted from Seddon and Kiew (1994).

Item	Wording	Source
Satis1	English: The IS adequately meets the information processing needs of my area of responsibility. German: Das IS erfüllt gut die Anforderungen an Datenverarbeitung in meinem Verantwortungsbereich.	Seddon & Kiew, 1994; Urbach, Smolnik, & Riempp, 2010
Satis2	English: The IS is efficient. German: Das IS ist effizient.	
Satis3	English: The IS is effective. German: Das IS ist effektiv.	

Satis4	English: Overall, I am satisfied with the IS. German: Insgesamt bin ich mit dem IS zufrieden.	

Table 26: Items pertaining to Satisfaction.

3.2.4 Net Benefits

This category refers to the Net Benefits for managerial accounting as discussed in the previous chapter.

3.2.4.1 Cost Savings

Table 27 lists the four items pertaining to the latent variable Cost Savings. They are all own creations based on the discussion of managerial accounting Net Benefits for SMEs in section 2.3.1.

Item	Wording	Source
Cost1	English: Using the IS allows the company to operate more cost-efficiently. German: Der Einsatz des IS ermöglicht es dem Unternehmen kosteneffizienter zu arbeiten.	Own creation
Cost2	English: The IS helps reducing unnecessary costs. German: Das IS hilft unnötige Kosten zu senken.	
Cost3	English: Using the IS allows me to identify sources of wastage. German: Durch den Einsatz des IS kann ich Quellen von Verschwendung identifizieren.	
Cost4	English: Overall, the IS reduces the costs incurred by the company. German: Ingesamt senkt das IS die im Unternehmen verursachten Kosten.	

Table 27: Items pertaining to Cost Savings.

3.2.4.2 Better Cooperation

Table 28 lists the four items pertaining to the latent variable Better Cooperation. They are all own creations based on the discussion of managerial accounting Net Benefits for SMEs in section 2.3.1.

Item	Wording	Source
Coop1	English: The IS makes it easier for people to work together. German: Das IS erleichtert die Zusammenarbeit.	Own creation
Coop2	English: The IS improves collaboration among employees. German: Das IS verbessert die Zusammenarbeit unter Mitarbeitern.	
Coop3	English: Thanks to the IS, employees can make better use of their colleagues' abilities. German: Dank des IS können Mitarbeiter gezielter auf die Fähigkeiten ihrer Kollegen zurückgreifen.	
Coop4	English: Overall, the IS improves cooperation in the company. German: Ingesamt verbessert das IS die Zusammenarbeit im Unternehmen.	

Table 28: Items pertaining to Better Cooperation.

3.2.4.3 Reduced Uncertainty

Table 29 lists the four items pertaining to the latent variable Reduced Uncertainty. They are all own creations based on the discussion of managerial accounting Net Benefits for SMEs in section 2.3.1.

Item	Wording	Source
Unc1	English: The IS allows me to produce accurate forecasts. German: Das IS ermöglicht es mir, zutreffende Voraussagen zu treffen.	Own creation

Item	Wording	Source
Unc2	English: The IS provides relevant information for decision-making. German: Das IS liefert relevante Informationen für die Entscheidungsfindung.	
Unc3	English: The IS reduces the risk of making wrong decisions. German: Das IS verringert das Risiko, eine falsche Entscheidung zu treffen.	
Unc4	English: Overall, the IS improves transparency about the company's environment. German: Ingesamt erhöht das IS die Transparenz über das Unternehmensumfeld.	

Table 29: Items pertaining to Reduced Uncertainty.

3.3 Answer Scales

The following statement precedes each set of items, with the exception of General Information, where answer formats cannot be standardised across items.

> English: What is your assessment, based on your professional experience, of the following statements with respect to your company?
>
> German: Ausgehend von Ihrer Berufserfahrung, wie schätzen Sie die folgenden Aussagen über Ihr Unternehmen ein?

Participants are offered a 5-point Likert scale (Likert, 1932, pp. 15-28) to indicate their opinion on each item. Figure 15 shows the scale. The scaling is intended to enable them to differentiate more thoroughly between statements and thus give a more accurate indication of their opinion (Berekoven, Eckert,

& Ellenrieder, 2004, pp. 81-82; Jacoby & Matell, 1971, pp. 495-496; McKelvie, 1978, pp. 198-199)

Strongly agree	Agree	Indifferent	Disagree	Strongly disagree
☐	☐	☐	☐	☐

Figure 15: Answer scale.

Schwarz et al. (1991) investigate the effect of numeric values in participants' perception of the meaning of the scale. They find that interpretation varies depending on whether the continuum of answers includes negative values or high values. Moreover, participants tend to interpret the midpoint as a typical or normal answer. (Schwarz, 1999, p. 98; Toepoel, Das, & Soest, 2009, p. 510) In order to address both of these issues, the answer scale does not show any numbers at all. In addition, each point on the scale is labelled. The midpoint's label, "Indifferent", still presumes an opinion and does not simply say "Do not know".

All items give a positive statement except for Form4, Resp1 and Flex3, which deliberately make negative statements. They will be reverse-coded in the statistical evaluation. This departure from the continuous pattern is done to check the reliability of the answers and to prevent participants from just ticking off one column because all items tend in the same direction.

3.4 Designing the Survey

3.4.1 Advantages of Online Surveys

The first step in designing a questionnaire is to decide whether to conduct the survey via mail, online or both. This decision will determine what is to be done at each of the subsequent steps.

Truell, Bartlett and Alexander (2002) compare the two approaches and evaluate them according to response rate, speed and completeness. They

find no significant difference in response rate, but completeness is significantly higher for the online survey. The speed with which responses come in was also much higher for the online survey: After 5 days, their online survey had already accumulated over 40% of total responses, whereas the mail survey was around 0%.

A similar study was conducted by McDonald and Adam (2003). For the criterion "speed and efficiency", they report a lower response rate and a higher rate of invalid addresses for the online survey compared to the postal survey. Table 30 is adapted from their paper and shows the exact numbers. Their study shows a pattern of a high initial response rate for the online survey. After two days, over 50% of total responses had accumulated. It took the postal survey ten days to cross the 50%-threshold. In terms of data quality, the postal survey showed a number of missing items, but the difference was not statistically significant.

	Online	**Postal**
Sent	3,900	1,026
Undelivered (invalid address)	700 (18%)	6 (< 0.5%)
Completed	826	471
Response level (%)	21	46

Table 30: Response level for online and postal surveys.
Adapted from McDonald & Adam, 2003, p. 89.

McDonald and Adam also point out that "traditional marketing research is suffering from falling participation rates, rising costs, respondent fears concerning misuse of personal information and managerial issues resulting from the time taken to conduct postal surveys […] In contrast, a number of claimed advantages are put forward for using online data collection methods in survey research, in particular: lower costs; faster turnaround; higher response levels; lower respondent error; broader stimuli potential through the inclusion of colour, graphics and sound; flexibility in the form of adaptive questioning; and even greater enjoyment" (2003, p. 86).

This citation summarises the advantages and challenges of online surveys. Researchers benefit from a more time- and cost-efficient survey method and respondents have the opportunity to participate in an easily administered and well-designed survey. Therefore, the obvious choice for this dissertation is to concentrate on an online survey only.

3.4.2 SoSciSurvey as the Survey Tool

There are many tools for conducting online surveys. Most of them differ only slightly and would accomplish the task equally well. Which tool to choose depends very much on the individual characteristics of the survey and the way of conducting it. SoSciSurvey (SoSci Survey, 2012) has certain features, which are not exclusive to this tool, but which nevertheless render it well-suited to carry out the survey for this dissertation:

- It is an online tool in the form of a website. No additional software is required except for a web browser.
- The use of the website is free of charge for academic purposes. This adds to the point that online surveys are most cost-efficient.
- It offers extensive freedom of customisation, ranging from templates to the addition and modification of HTML and PHP code. All the design and layout requirements discussed in the next section depend on the ability to customise the website.
- The organisation of questions follows the idea of structural equation modelling. Items can be assigned to questions (i.e. constructs) and the output data set reflects that organisation.
- There is a special pretesting mode for questionnaires. In that mode, access to the survey can be restricted by a password. Testers can go through the different questions and leave written comments. Their answers are not included in the final data set.
- The output data set can be any standard file format, which will be useful later on when analysing the data.

3.4.3 Design and Layout

In the case of online surveys, the communication between researcher and participant is important because the first is not present when the latter fills in the questionnaire. Unlike with personal or telephone interviews, participants have to make do with whichever information the researcher has provided them with. If they misinterpret the researcher's intention or lack proper motivation, the quality of the survey will suffer as a consequence. Design and layout of the survey website are important in guiding the participant. (Couper, Traugott, & Lamias, 2001, pp. 230-231; Toepoel et al., 2009, pp. 509-510)

While layout refers to the size and arrangement of elements on the website, the term "design" is more illusive. Paul Rand offers the following definition: "Design is a problem-solving activity. It provides a means of clarifying, synthesizing, and dramatizing a word, a picture, a product, or an event." (Rand, Paul, 2012) The problem in the present case is to convey the meaning and importance of the survey and its questions to the participant. Therefore, design is not just about how the website looks, but about how the looks help solve the problem.

The following is a description of what has been done to design the survey with the purpose of reporting the thought-process behind the design. Other researchers may draw on the lessons learnt here when planning their own survey. Guidance for judging design can be found in Dieter Rams' "10 principles for good design" ("Dieter Rams," 2012). However, a full and substantial discussion of design is outside the scope of this dissertation.

Figures 16 and 17 are shown at this point as examples for the subsequent statements regarding design and layout. All pages of the questionnaire are included in appendix A1.

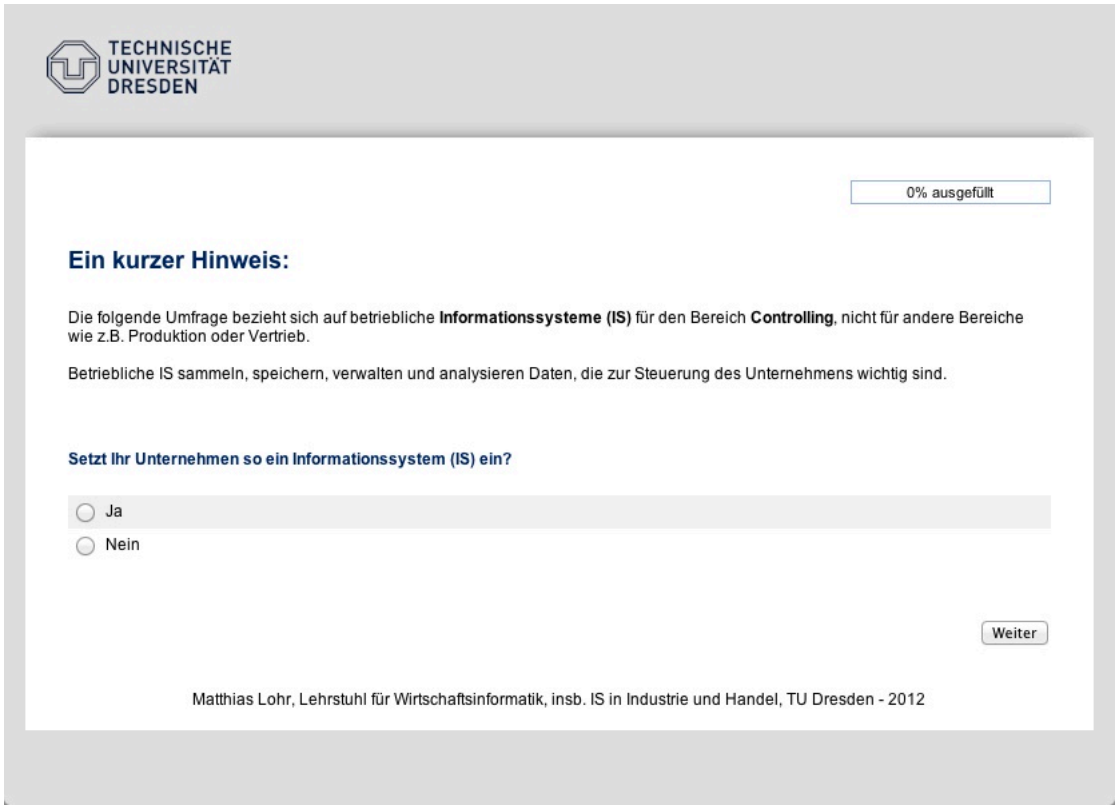


Figure 16: Page 1 of the questionnaire.

Figure 17: Page 4 of the questionnaire.

One major aspect of the design is colour. The background is light grey (88% white in black-white-spectrum) to lend the page a certain texture. It guides the eye towards the white (100%) part of the page which contains the instructions, the questions and all interaction elements. Body text, answers and the imprint are printed in black (0%) to give the best possible readability and contrast. Headlines are printed in a dark blue (11-41-80 in RGB space) derived from the TU Dresden logo. The alternative colour denotes elements of special importance, i.e. the TU Dresden logo to represent the institution and the headlines to draw participants' attention to the instructions. For the same reason, the triangle illustrating the answer scale is kept in the same dark blue. The light gray colour of the background is also used as a contrast for alternating rows of answers to increase readability. A light blue colour

(155-176-218), derived from the Chair's logo, is used for the current answer selection as well as for the progress bar.

With regard to typography, Helvetica (i.e. Arial in compliance with websafe fonts) is the only font used. The clarity of the typeface and the lack of serifs underline the transparent, open and scientific purpose of the survey. Furthermore, the font is widespread and participants should be familiar with it. Font size is 12 points for all texts, except special exclamations only to be found on the first and last page. Bold typeface is used to highlight headlines and keywords in the body text. Underlined typeface is used to draw participants' attention to differences in the instructions.

In terms of size, the website is 800px wide which can be easily displayed on any modern screen. A page's height depends on the number of questions and items displayed. For the survey pages, the height ranges between 600px and 806px.

The contrast in colour for the background and foreground gives the visual clue of dimension, i.e. a white page in the foreground upon a slightly darker background. This is further supported by the drop shadow above the white space. The purpose here is to give participants the impression of an actual sheet of paper which they might be more willing to deal with than a technical-looking website resembling their computer's system settings. The black-white contrast is important for readability, but an entirely white website without a contrasted background would give fewer visual cues to the eye. Here, participants are guided from the top-left element (the TU Dresden logo), across the page to the bottom-right element (the "Next"-button) following their natural flow of reading.

The layout of the website is divided into two major parts: the background, including the header and free space on the left, right and bottom of the page, and the foreground, including the instructions, questions and navigation elements. The foreground features a progress bar in the top right corner. Next, the question is posed, followed by a short explanatory text. Beneath

the question, the answer scale and the items are presented. A blue triangle, which denotes declining consent across the scale, is the only graphical element. The “Next”-button is positioned at the bottom right corner. The last element is the imprint, which is centred at the bottom of the page. All elements are aligned within a 32px margin on either side of the page.

The number of questions and items shown on each page largely determines the layout, but can also influence the participants’ train of thought. Items are grouped by the question or construct they relate to. Thus, if they are shown together, the participant is already thinking about the construct and can more readily indicate his opinion. On the other hand, responses to items of the same group might exhibit correlation just because of their visual proximity as the respondent ticks them all off equally. Couper, Traugott and Lamias have investigated this problem. They find that “the correlations are consistently higher among items appearing together on a screen than items separated across several screens. However, the overall effect is not large, and none of the differences between each pair of correlations reach statistical significance” (2001, p. 244). Another result of their study is that the increase in speed, with which participants fill in the questionnaire, is statistically significant when multiple items are shown on one page. Using these results in the present survey, no page shows more than 12 items, but keeps items in logical groups.

3.4.4 Questionnaire

The questionnaire consists of 11 separate pages which are described in table 31. Whenever multiple items pertain to a single question, the items are shown in random order for each participant. No default answer is set and participants are at liberty to leave items unanswered. However, there is no possibility to return to a previous page in order to avoid tweaking the survey.

Page	Description	Questions
1	Welcome screen, explaining which kind of IS the survey refers to.	Filter question if the company deploys an IS. If no, participants are directed to page 10.
2	General Information	Zip-code, industry, year of foundation
3	General Information	Position in the company, number of employees, revenue in 2011
4	Information Quality	First 10 items
5	Information Quality	Second 10 items
6	System Quality	First 12 items
7	System Quality	Second 12 items
8	Use of the system	Satisfaction and Perceived Usefulness
9	Benefits	Cost Savings, Better Cooperation, Reduced Uncertainty
10	Voluntary entry of email-address to receive information about the results	
11	"Thank you" screen	

Table 31: Pages of the online questionnaire.

3.4.5 Website

Potential participants of a web survey often lack motivation to fill in the questionnaire or their managers have set other priorities. (McDonald & Adam, 2003, p. 86) The problem is similar to the issues of trust, risk and opportunism as discussed in Neo-institutionalism. In order to establish trust between two parties, they have to overcome the risk (e.g. information asymmetry) of opportunism (e.g. hidden intentions). (Ring & van de Ven, 1992, pp. 487-489) Translated to the present survey, the participant may wonder whether the information he volunteers is really kept anonymous or

whether he will really receive the results of the survey and thus benefit personally.

Nooteboom, in a paper on inter-firm cooperation, defines trust as follows: “X trusts Y to the extent that X chooses to cooperate with Y on the basis of a subjective probability that Y will choose not to employ opportunities for defection that X considers damaging, even if it is in the interest of Y to do so” (1996, p. 993). Based on this definition, the risk of opportunism can be reduced by minimising information asymmetry and signalling trustworthy intentions. Consequently, the other party will be less likely to defect from the cooperation.

The website www.lohr-dissertation.de, which has been set up to accompany the online survey, intends to do exactly that. All the pages of the website are included in appendix A2. Each of the following measures is aimed at building trust between the researcher and the potential participants:

- The very existence of the website is a signal that the researcher has a priori invested thought, time and effort in building a relationship.
- Right at the top of the home page is a picture of the researcher, thereby voluntarily giving up anonymity.
- There is a link to a QuickTime and YouTube video, in which the researcher personally explains the importance of the survey and how he intends to interact with the participants.
- The home page gives answers to the following typical concerns: Why is the survey necessary? Who are the participants? Is the survey anonymous? How is the data being used? Who pays for the survey? Do I get the results?
- The second page provides further information about the research question and why it is of interest to the participants.
- This page also contains contact details and information about the Chair, thereby emphasising support for the survey.
- The website links directly and prominently to the survey, thus making it convenient to participate.

The website follows the same design as described earlier, thereby giving a consistent look and feel to all elements of the survey. Of course, the effect of the website on the response rate or the quality of the data cannot be ascertained. There is no control group, which was not informed about the website. However, the excerpt from the web server's log shown in figure 18 gives an indication of the interest in the website.

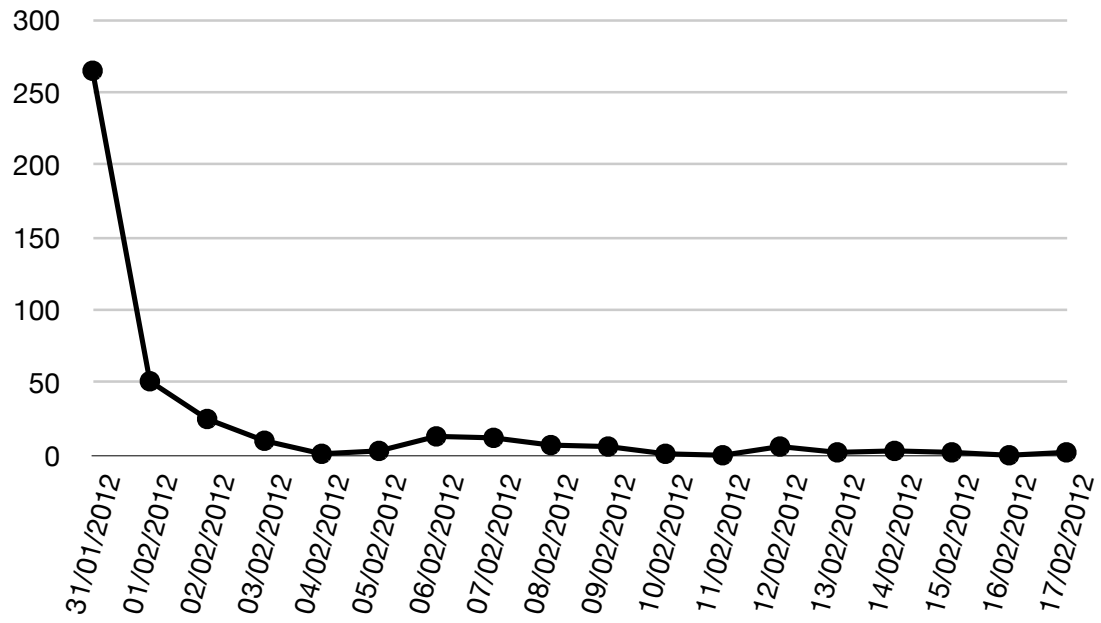


Figure 18: Unique hits on the website.

On the day the survey started, the website had 265 unique hits. The spike in attention coincides with the bulk of answers, which were also given on the first day.

3.5 Pretesting

Pretesting is an important step in conducting the survey. The researcher has presumably great and in-depth knowledge about the research object. Participants, on the other hand, obtain most of their knowledge and context from the survey questions. Pretesting can contribute to minimising the risk of misunderstandings. Even though many items have been adapted from prior

research, some items are new and all items have been translated into German. Therefore, the proposed research model is a hitherto unvalidated instrument in IS research. Pretesting can increase content validity and subsequently construct validity. (Boudreau et al., 2001, pp. 2-6; Straub, 1989, pp. 147-157)

Straub (1989, pp. 156-157) provides an example of several rounds of pretesting, where suggestions from the first round are tested in the second round and so on. His group of pretesters is chosen to obtain "maximum feedback from various expertises, organizational roles, and geographical regions". The same approach is adopted for the pretesting in this dissertation.

3.5.1 Round 1

The first round of pretesting started on January 10th, 2012 and lasted for a week. Pretesters were sent an email explaining the purpose of their involvement, as well as containing links to the survey and the website. Feedback could be provided through the survey website or via email. The composition of pretesters (see table 32) allowed for different perspectives on the questionnaire, including scholars, practitioners and creative professionals.

Pretesters	
Practitioners	5
Scholars	3
Creative Professionals	2
Total	**10**

Table 32: Composition of pretesters in round 1.

The following issues were raised by one or more pretester during the first round:

- Purpose of the questionnaire needs to be explained upfront.
- The term “information systems” needs clarifying.
- The wording of the questions is always very similar; differences should be highlighted.
- Inclusion of filter question to later eliminate unsuitable responses.
- Video on the website is blocked by company’s IT security.
- Long list of items for Information Quality and System Quality is tiresome.
- A few typographical mistakes.

All these issues were corrected before proceeding to the second round. First and foremost, the items for Information Quality and System Quality were split and presented on two pages each. The problem with the video on the website was difficult to resolve. While the implementation on the website was correct and compliant with the HTML-standard, most companies did not allow any video to be played due to security concerns and outdated web browsers. Ultimately, the video was moved to a subpage for those with the capability to view it and replaced by a photo on the home page.

3.5.2 Round 2

Round 2 was conducted by different pretesters, whose composition is shown below. It started on January 18th, 2012 and also lasted for a week. The same email and instructions were used as in the first round.

Pretesters	
Practitioners	6
Scholars	3
Creative Professionals	1
Total	**10**

Table 33: Composition of pretesters in round 2.

The following issues were raised by one or more pretester during the second round:

- Some family businesses do not like to report their revenue. Inclusion of a “no response”-option to prevent participants from aborting the questionnaire.
- Formatting the revenue field in million euros and allowing for decimals.
- The term “Controlling” needs clarifying.

None of the issues, which were resolved after the first round, were raised again in the second round. In addition, the suggestions in the second round were minor and quickly implemented. Therefore, no third round of pretesting was conducted.

3.6 Administering the Survey

3.6.1 The Dataset

Industry Code	**Frequency**	**Density**
331. Primary Metal Manufacturing	382	7%
332. Fabricated Metal Product Manufacturing	1,788	31%
333. Machinery Manufacturing	1,719	29%
334. Computer and Electronic Product Manufacturing	756	13%
335. Electrical Equipment, Appliance, and Component Manufacturing	447	8%
336. Transportation Equipment Manufacturing	266	5%
337. Furniture and Related Product Manufacturing	206	4%
339. Miscellaneous Manufacturing	267	5%
Total	**5,831**	**100%**

Table 34: Frequencies and densities of industries in the dataset.

The dataset consists of 5,957 email-addresses belonging to 5,831 companies obtained from the Amadeus company database ("Amadeus," 2012) accessed through the SLUB website. The difference is due to the fact that for some companies, two or more email addresses are listed. This constitutes all the companies listed in the database, which are subgroups of the North American Industry Classification System (NAICS) 2007 primary code “33. Manufacturing”.

3.6.2 Bulk-Mailing

Sending close to 6,000 emails at once through a standard email account is a challenge. However, the use of a TU Dresden email-address would further increase the credibility of the survey. The problem could be solved by using MaxBulk Mailer SE Version 8.3.5 for Mac OS X, which could handle the amount of email-addresses and efficiently send it to the outgoing mail server.

The following text was sent out:

> Sehr geehrte Damen und Herren,
>
> mein Name ist Matthias Lohr. Als Doktorand an der TU Dresden führe ich eine Umfrage bei kleinen und mittleren Industrieunternehmen durch.
>
> Dabei untersuche ich, wie diese Betriebe Informationssysteme einsetzen, um besseres Controlling durchführen zu können.
>
> Die Umfrage ist zentral für meine gesamte Dissertation und Sie würden mir sehr helfen, wenn Sie folgenden Fragebogen (Dauer ca. 10 Minuten) beantworten:
>
> https://www.soscisurvey.de/lohr/
>
> Sie selbst sind nicht für das Controlling verantwortlich? In diesem Fall bitte ich Sie freundlich, diese E-Mail an den richtigen Ansprechpartner oder die Geschäftsleitung weiterzuleiten.
>
> Die Umfrage läuft bis zum 17. Februar und ist natürlich vollständig anonym. Wenn Sie Fragen haben oder mehr über die Umfrage erfahren möchten, besuchen Sie bitte meine Website:
>
> http://www.lohr-dissertation.de

Herzlichen Dank für Ihre Unterstützung!

Viele Grüße
Matthias Lohr

English translation:

Dear Sir or Madam:

My name is Matthias Lohr. As a doctorial student at the TU Dresden I conduct a survey among small and medium sized industrial firms.

Thereby I investigate how these companies deploy information systems in order to better conduct managerial accounting.

The survey is pivotal for my dissertation and you would greatly oblige me if you were to fill in the following questionnaire (duration approx. 10 minutes):

https://www.soscisurvey.de/lohr/

You are not responsible for managerial accounting? In that case I kindly ask you to forward this email to the right contact or the management board.

The survey is open until February 17th and is of course completely anonymous. If you have any questions or would like to learn more about the survey, please visit my website:

http://www.lohr-dissertation.de

Thank you very much for your support!

Yours sincerely,
Matthias Lohr

The distribution of the mails started at 10pm on January 30th, 2012 with a pilot run of all companies in the sample set whose name starts with the letter A (1,035 companies). The mail client was initially set to send mails in groups of 100 at 1:30 intervals using three outgoing SMTP connections. This first run was successful, but some of the outgoing connections were closed by the server. For the remaining lot, the number of connections was reduced to two. The second run, too, was successful and all emails were sent out within about four hours. Over the subsequent days, 714 mails could not be

delivered as indicated by notification mails either from the sending or receiving mailservers.

3.6.3 Response Rate

The response rate is calculated in table 35.

Email addresses	**5,957**	
Duplicates	87	1.5%
Postmaster	5	0.1%
Emails sent	**5,865**	
Delivery Failed	714	12.2%
Emails delivered	**5,151**	**87.8%**
Total responses	507	9.8%
Completed questionnaires	323	6.3%
Useful responses	**177**	**3.4%**

Table 35: Response rate.

The calculation shows first of all the quality of dataset with almost 88% valid email addresses. Postmaster addresses were excluded due to the risk of triggering a spam filter, either on the sending or the receiving mailserver. Of all emails delivered, over 6% completed the questionnaire.

Due to the comparatively high response rate, the minimum number of cases for LISREL can be met with a restriction on missing values of only 5%. That means that any response, where more than 5% of items are left unanswered, is excluded from the sample. The remainder still amounts to 177 useful responses (3.4%).

Another interesting statistic is the speed with which responses were obtained. The first day of the survey accounted for 71% of total responses. The earliest response came in at 6.55am and six hours and four minutes later, the cumulative number of responses crossed the 50%-threshold.

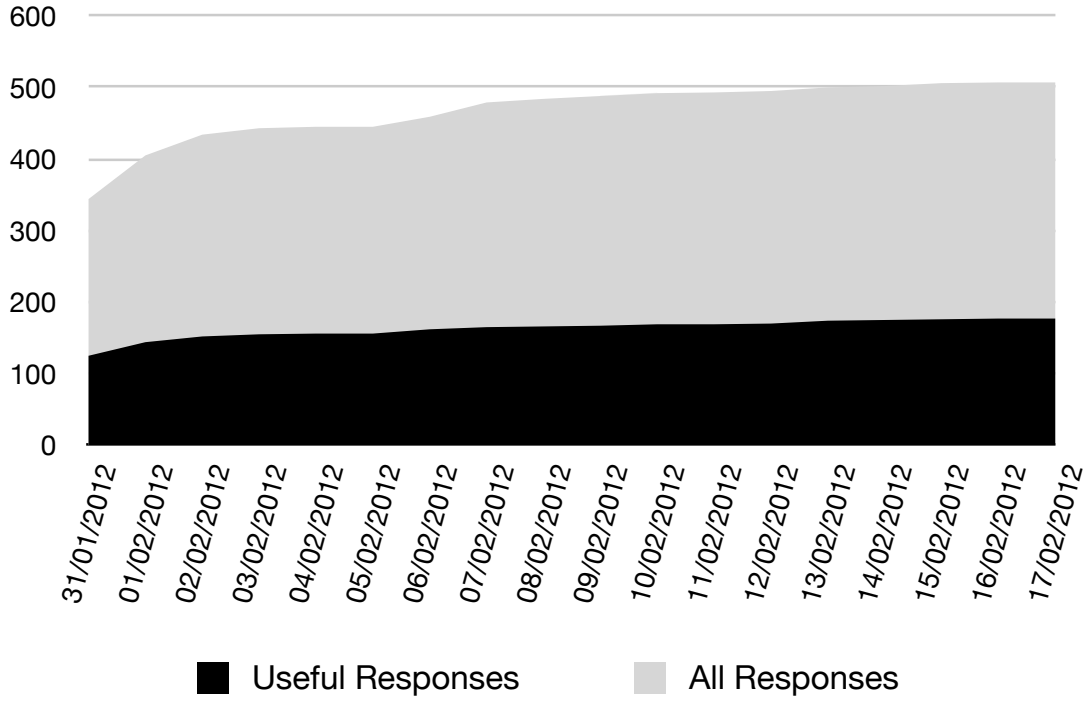


Figure 19: Cumulative responses.

4 Results

This chapter presents the results of the survey in three steps. First, descriptive statistics are used to analyse the general information, which was gathered in the survey. This gives some indication with regard to the characteristics of the responding companies in contrast to the dataset and, where possible, to the relevant population of companies in Germany as a whole. Doing so addresses the issue of whether or not the sample is biased compared to the dataset. Another issue is the question how far the dataset and sample can be seen as representative of the population.

Second, the items and constructs are tested for unidimensionality and reliability. The data is evaluated using LISREL and maximum likelihood (ML) as an estimation method. Resulting parameter estimates include loadings of manifest variables on their respective construct, the relationships among constructs, error terms associated with variables in the model and the predictability of dependent variables. Furthermore, it is assessed how well the model fits the data. While this is confirmatory and not exploratory research, it is still important to judge how well the research model can explain the data.

Third, the twenty hypotheses developed in chapter 2 are evaluated based on the parameter estimates. Some hypotheses may be rejected or accepted with varying degrees of confidence and statistical significance. These results form the basis for the discussion in the subsequent chapter.

4.1 Software Used for Analysis

Two software packages were used for analysing the results. R version 2.14.0 was used for data preparation such as dealing with missing values and reverse-coding certain items. Stata version 12.1 was used for estimating the structural equation model as well as for all statistical tests of items,

constructs and the model. Graphs were produced with Stata and Numbers verison 2.1. All software ran under Mac OS X version 10.7.

4.2 Sample Description

4.2.1 Respondents

This section deals with the question of who responded to the survey. In order to establish some picture about the respondents, several criteria were asked in addition to the item statements. Items GI1 to GI8 include information about revenue in 2011, number of employees, year of foundation, industry and zip-code. These criteria are objectively measureable and allow for comparison with the dataset and, where possible, with the relevant population of companies in Germany.

	Mean	**Minimum**	**Maximum**
Revenue	EUR 54.2m	EUR 3.9m	EUR 540.0m
Employees	299	50	3500
Foundation	1957	1804	2009

Table 36: Arithmetic means, minimum and maximum values for revenue, employees and year of foundation.

Table 36 shows that on average, the respondent's company turned over EUR 54.2 million in 2011, employs 299 people and was founded in 1957. Beside the arithmetic means, the minimum and maximum values are also included in the table. However, means reduce a range of values to a single number. In order to report the breadth of the data, table 37 shows the 25%, 50% and 75% quartiles, i.e. the values above which 25%, 50% and 75% of all other values lie in a sorted data array. The comparison reveals that half of all responding companies turned over between EUR 18 and EUR 65 million in 2011, have between 120 and 320 employees and were founded between 1932 and 1991. As demonstrated by these numbers, the mean revenue is clearly distorted by a few large outliers.

	25% Quartile	Median	75% Quartile
Revenue	EUR 18.0m	EUR 33.0m	EUR 65.0m
Employees	120	185	320
Foundation	1932	1969	1991

Table 37: 25%, 50% and 75% quartiles for revenue, employees and year of foundation.

The three box plot diagrammes (figures 20, 21 and 22) illustrate the values of table 37 graphically. They show that revenue is largely confined to a range up to EUR 175 million with a few companies having turned over manifold that. The same is true for the number of employees, even though here the outliers are more numerous and equally distributed. The majority of companies falls within the SME definition discussed in section 1.3.3, which gives an upper limit of EUR 50m in annual revenue and 249 employees. Some companies would be considered large enterprises, but only based on the quantitve criteria. Qualitative criteria are hard to discern in a survey. Furthermore, the dataset includes the number of employees only for a fraction of firms and annual revenue only for an even smaller fraction. An a priori selection based on these quantitative criteria would have arbitrarily reduced the dataset below a useful size. An ex post selection would still have to rely on quantiative criteria only, whereas qualitative criteria are equally important. While it is not a criterion for SMEs, it is still interesting to observe that most companies were founded in the 20th century, with just a few reaching back to the 19th century.

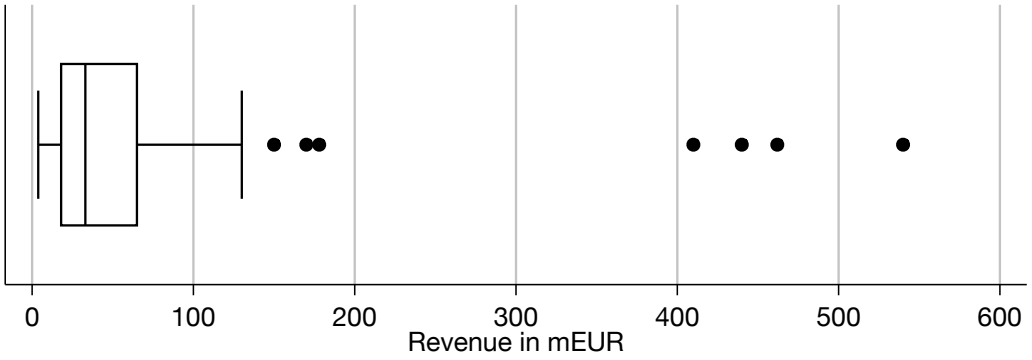


Figure 20: Box plot of revenue in 2011.

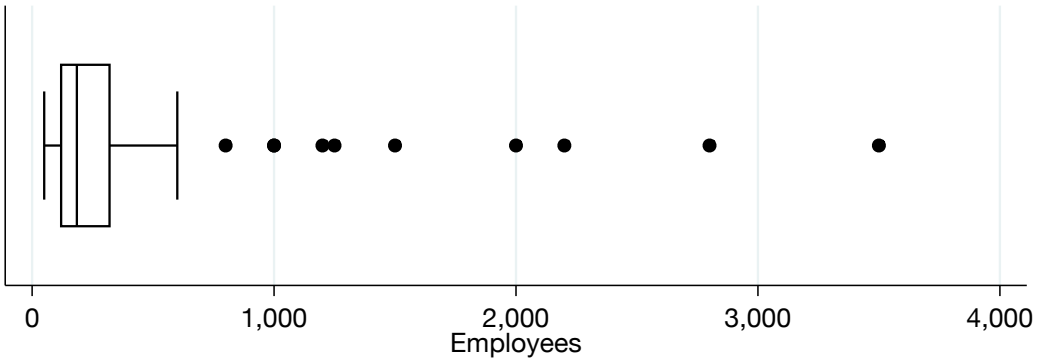


Figure 21: Box plot of number of employees.

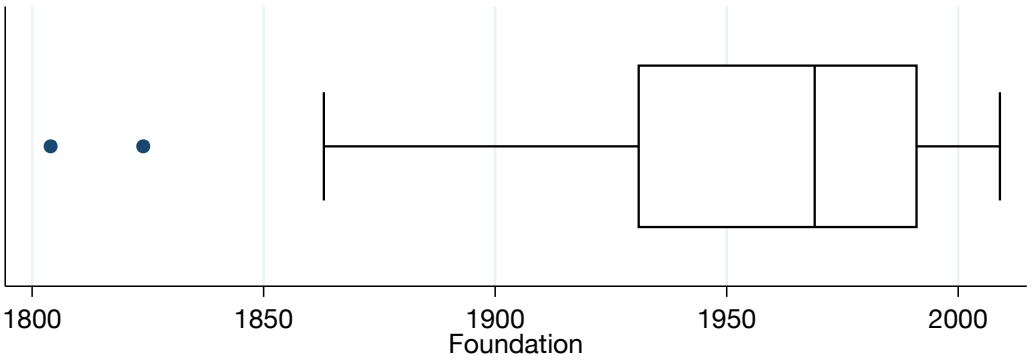


Figure 22: Box plot of year of foundation.

Another characteristic of repsonding companies is the industry they belong to. Table 38 compares the density of industries (by NAICS 2007 primary codes) in the dataset to their density in the sample.

Some companies did not find any of the options in the questionnaire adequate to describe their industry. Their free text responses are listed in appendix A3.

German	Codes	Sample		Dataset	
Metallverarbeitung	331 & 332	38	21%	2,170	37%
Maschinenbau	333	64	36%	1,719	29%
Herstellung von Elektrogeräten	334 & 335	8	5%	1,203	21%
Automobilzulieferung	336	15	8%	266	5%
Möbelherstellung	337	5	3%	206	4%
Sonstige	339	47	27%	267	5%
Total		**177**	**100%**	**5,831**	**100%**

Table 38: Frequencies and densities of industries in the sample and dataset.

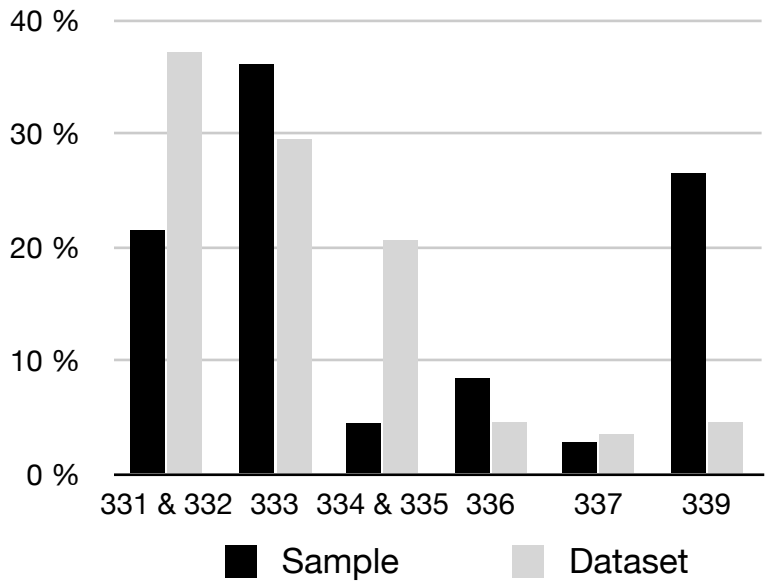


Figure 23: Density distribution of industries by NAICS in the sample and dataset.

Besides general information about their company, respondents were also asked to indicate the position they hold. The most frequent response is

Managerial Accountant, followed by Commercial Director, Managing Director and CFO (see table 39). Other, free text responses are also listed in table 40.

English	German	Frequency	Density
Managing Director	Geschäftsführer	29	16%
Chief Finance Officer	Leiter Finanzen / Rechnungswesen	27	15%
Commercial Director	Kaufmännischer Leiter	32	18%
Accountant	Buchhalter	2	1%
Managerial Accountant	Controller	71	40%
Director of IT	IT-Verantwortlicher	2	1%
Other	Sonstige	14	8%
Total		**177**	**100%**

Table 39: Respondents' position in the sample.

English	German	Frequency
Head of Finance and Managerial Accounting	Leiter Finanzen und Controlling	1
Head of Managerial Accounting	Leiter Controlling	5
Head of Quality Assurance	Leiter QS	1
Assistant to the Commercial Director	Assistent kaufmännische Leitung	1
Assistant to the Management Board	Assistent der Geschäftsführung	1
Human Resources / Managerial Accounting	PW/Controlling	1
Secretary	Sekretariat	1
Total		**11**

Table 40: Other positions.

Another criterion is the company's zip-code. Table 41 follows the same approach as before of comparing the density of each zip-code in the sample and the dataset. Figure 24 illustrates the density without the missing values in the sample, because they distort the relative frequencies of the proper zip-codes. The comparison shows a close match with a correlation coefficient of 0.86 between the sample and the dataset.

	Sample		**Dataset**	
Zip-Code	**Frequency**	**Density**	**Frequency**	**Density**
0…	18	10%	543	9%
1…	5	3%	196	3%
2…	14	8%	358	6%
3…	23	13%	716	12%
4…	14	8%	690	12%
5…	17	10%	818	14%
6…	7	4%	373	6%
7…	25	14%	996	17%
8…	13	7%	526	9%
9…	15	8%	615	11%
No response	26	15%		
Total	**177**	**100%**	**5,831**	**100%**

Table 41: Frequencies and densities of zip-codes in the sample and dataset.

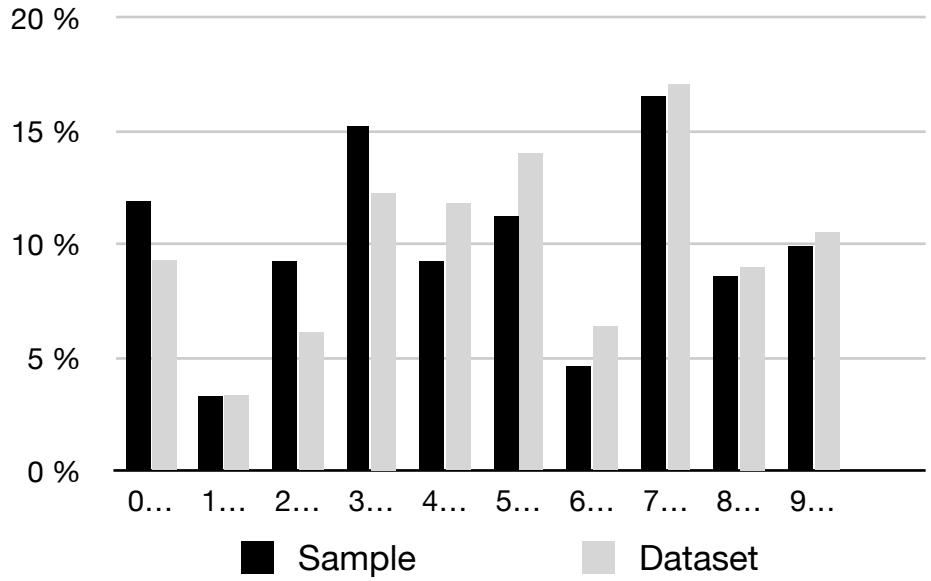


Figure 24: Density distribution of zip-codes in the sample and dataset. "NA"-values in the sample have been excluded.

4.2.2 Response Bias

Despite the good return rates, respondents might still be systematically different from non-respondents. If this is the case, results cannot readily be generalised to the whole population. Van Goor and van Goor (2007) acknowledge these problems and discuss a straight-forward solution: "to persuade people to be interviewed who have previously refused" (van Goor & van Goor, 2007, p. 222). If such a follow-up survey was successful, it would certainly reveal if initial respondents differ systematically from initial non-respondents. However, because the survey conducted in this dissertation is anonymous, there is no way of knowing which companies have responded. Table 35 in the previous chapter shows that 9.8% of those companies who had received an email invitation filled in the questionnaire at least partially, even though only 3.4% ultimately provided data that was sufficiently complete. Thus, if randomly following-up companies, the chance of contacting respondents from the first round is considerable. This would be both a futile effort and an annoyance to the companies.

Armstrong and Overton (1977) offer an alternative, albeit more indirect approach to determining response bias. They suggest three methods, which can be combined to investigate whether or not an obtained sample is biased. First, a “comparison with known variables” shows whether respondents are biased towards a known criterion. Second, “subjective estimates” complement any numerical evaluation to better understand and assess potential sources of bias. Third, “extrapolation” compares early respondents to late respondents or respondents of a subsequent wave of questionnaires. Extrapolation is based in the assumption that respondents who either respond late to a survey or only after an additional stimulus are similar to non-respondents. (Armstrong & Overton, Terry S., 1977, pp. 396-397) The following sections deal with these three methods.

4.2.2.1 Comparison with Known Variables

There are two characteristics that can be traced and compared through the dataset and the sample: the primary industry and the zip-code. They are contrasted in tables 38 and 41 respectively. Excluding respones to the industry code indicating “other”, the correlation coefficient for the industry code is 0.72. Excluding “NA” responses in the sample, the correlation coefficient for the zip-code is 0.86. Both variables show strong correlation between the sample and the dataset, which means that respondents are not biased towards a certain industry or geographic region.

4.2.2.2 Subjective Estimates

Several things can be said about the respondents in the sample. All of these notions are entirely subjective, but nevertheless plausible. They are offered for the sole purpose of complementing the objective analyses of response bias. The first notion, and most obvious one, is that they diligently filled in nearly all of the questions. Of course, there were many more respondents who completed the questionnaire only partially, but their data is not useful and they are excluded from the sample. This leaves the diligant participants who, according to their job descriptions (see table 39) are predominantely in

a position to accurately judge their information system and its impact on conducting managerial accounting. Moreover, the vast majority of responses came in a matter of hours after having received the email invitation. This suggests that they took the survey seriously and wanted to participate, either for altruistic reasons or to voice their opinion.

By contrast, then, is it reasonable to assume that non-respondents are indolent, unqualified and listless? Probably not. However, respondents are naturally the kind of person one would assume to respond to a survey.

4.2.2.3 Extrapolation

Extrapolation will compare early respondents and late respondents. Because the first day alone accounted for 71% of responses, there are considerably more early respondents than late respondents. The survey was open from January 31st, 2012 through February 17th, 2012, a total of 18 days. Figure 25 below shows the number of responses on each day.

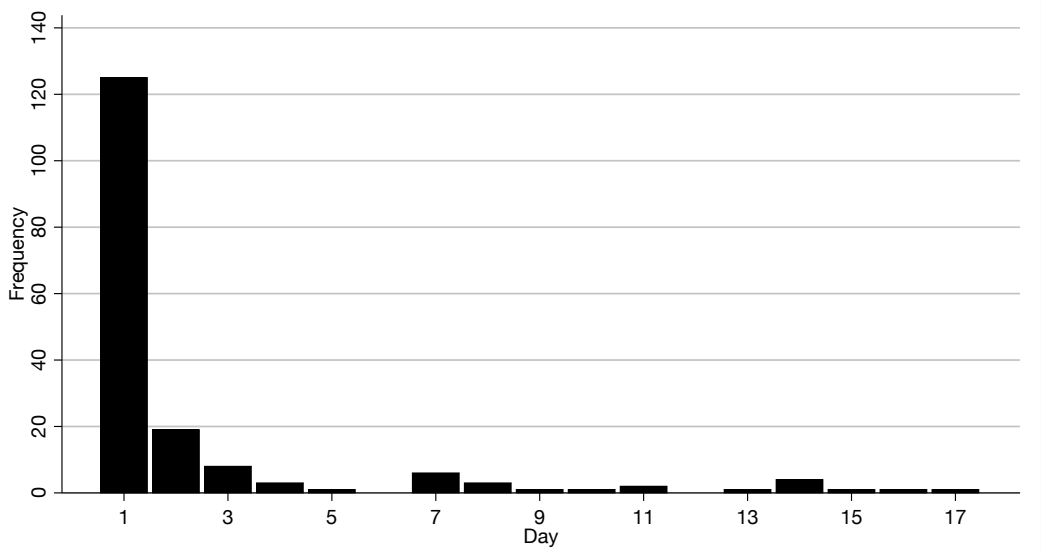


Figure 25: Reponses on each day.

For the purposes of investigating response bias, early respondents are defined as those who responded on the first two day (144 responses), the rest constitutes late respondents (33 responses). The sample is split into the two groups and the Kolmogorov-Smirnov test is used to determine whether

the distribuation of early respondents is significantly different from the distribution of late respondents for each item. Because the subsample of late respondents is comparatively small, “real p-values tend to be substantially smaller” (Hamilton & Stata, 2011, p. 895). A full report of the test results as well as the arithemtic means of the early and late responses can be found in appendix A4. Table 42 summarises the test results, indicating a significant difference between the distributions of the two subsamples if the corrected combined test is significant at the 95% level.

	Significant Difference	**Lower Mean Score**
Acc1	No	Late
Acc2	Yes	Late
Acc3	No	Late
Acc4	No	Early
Comp1	No	Late
Comp2	No	Late
Comp3	Yes	Late
Comp4	No	Late
Curr1	No	Late
Curr2	No	Late
Curr3	Yes	Late
Curr4	Yes	Late
Form1	No	Late
Form2	Yes	Early
Form3	No	Early
Form4	No	Early
Access1	No	Late
Access2	Yes	Late
Access3	Yes	Late
Access4	Yes	Late

	Significant Difference	Lower Mean Score
Rel1	No	Late
Rel2	Yes	Late
Rel3	Yes	Late
Rel4	No	Late
Resp1	Yes	Early
Resp2	Yes	Late
Resp3	Yes	Late
Resp4	No	Late
Flex1	Yes	Early
Flex2	Yes	Late
Flex3	Yes	Early
Flex4	Yes	Late
Int1	Yes	Late
Int2	Yes	Late
Int3	No	Late
Int4	No	Early
Use1	Yes	Early
Use2	No	Early
Use3	Yes	Early
Use4	Yes	Early
Use5	Yes	Early
Use6	No	Early
Satis1	No	Early
Satis2	Yes	Early
Satis3	Yes	Early
Satis4	No	Late
Info1	No	Early

	Significant Difference	Lower Mean Score
Info2	No	Late
Info3	No	Early
Info4	No	Late
Sys1	No	Late
Sys2	No	Late
Sys3	Yes	Early
Sys4	Yes	Late
Cost1	Yes	Late
Cost2	Yes	Late
Cost3	Yes	Early
Cost4	Yes	Late
Coop1	Yes	Late
Coop2	Yes	Late
Coop3	Yes	Late
Coop4	Yes	Late
Unc1	No	Late
Unc2	Yes	Early
Unc3	No	Early
Unc4	No	Early

Table 42: Response bias and direction in items.
Based on the corrected combined Kolmogorov-Smirnov test at the 95% confidence level.

The data in table 42 shows that for 36 out of 66 items the hypothesis of a difference between the distribution of early and late responses cannot be rejected at the 95% level. Thus slightly more than half of the items appear to be biased. In order to determine the extent of the bias, the arithmetic mean is calculcated for early repondents and for late respondents. For 42 out of 66 items, late responses have a lower mean. This does not conflict with the

Kolmogorov-Smirnov test, because not all differences are significant. Furthermore, the maximum difference between the artithemtic means of early and late respondents is 0.5 which equals half a point on the answer scale. While apparently there is a significant bias in some items, the extent of the bias and its effect on the data is relatively low.

4.2.3 Representativeness

Having established that there is fairly little bias in the reponses, the question remains how representative the dataset is in the first place. Data from the German Federal Statistics Bureau (Destatis, 2012) provides the frequencies and industries of manufacturing firms with 50 or more employees. The data shown in table 44 is for 2010, wich is the most recent year available. German industry descriptions have been mapped to the NAICS 2007 primary codes, which is shown in table 43.

The relevant sub-population comprises 12,128 companies, which means that the dataset covered 48%. Considering that the population data stems from 2010 and the dataset from 2011, as well as taking into account the fact that the mapping of industries is close, but not perfect, it can be said that the dataset comprises half the relevant population. Furthermore, figure 26 demonstrates how well the relative frequencies of each industry in the population correspond to the dataset.

German Industry Codes	NAICS 2007
WZ08-24 Metallerzeugung und -bearbeitung	331. Primary Metal Manufacturing
WZ08-25 Herstellung von Metallerzeugnissen	332. Fabricated Metal Product Manufacturing
WZ08-28 Maschinenbau	333. Machinery Manufacturing
WZ08-26 H.v. DV-Geräten, elektron. u. opt. Erzeugnissen	334. Computer and Electronic Product Manufacturing
WZ08-27 Herstellung von elektrischen Ausrüstungen	335. Electrical Equipment, Appliance, and Component Manufacturing
WZ08-29 Herstellung von Kraftwagen und Kraftwagenteilen	336. Transportation Equipment Manufacturing
WZ08-30 Sonstiger Fahrzeugbau	336. Transportation Equipment Manufacturing
WZ08-31 Herstellung von Möbeln	337. Furniture and Related Product Manufacturing
WZ08-32 Herstellung von sonstigen Waren	339. Miscellaneous Manufacturing

Table 43: Mapping of German industry codes to NAICS 2007.

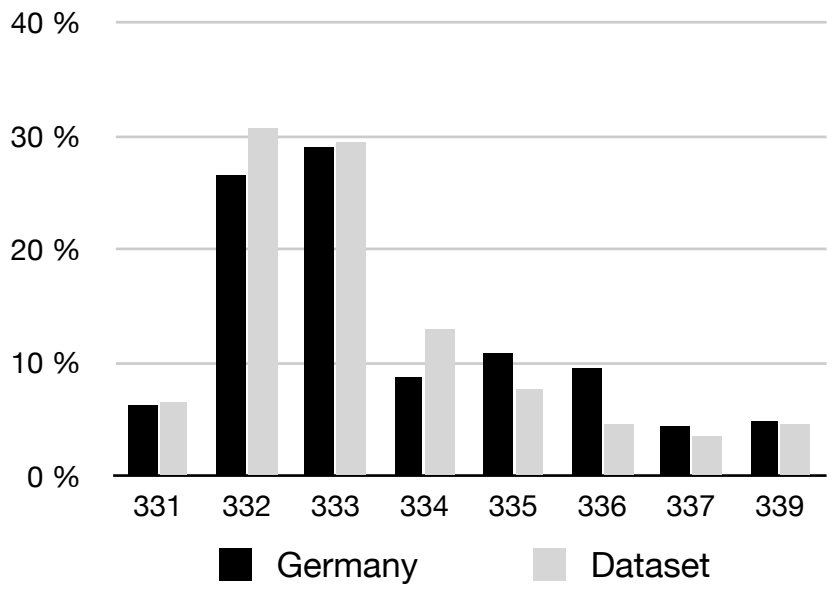


Figure 26: Density distribution of industries by NAICS in the population and dataset.

	Germany		Dataset	
Industry Code	**Frequency**	**Density**	**Frequency**	**Density**
331. Primary Metal Manufacturing	759	6%	382	7%
332. Fabricated Metal Product Manufacturing	3,215	27%	1,788	31%
333. Machinery Manufacturing	3,514	29%	1,719	29%
334. Computer and Electronic Product Manufacturing	1,058	9%	756	13%
335. Electrical Equipment, Appliance, and Component Manufacturing	1,315	11%	447	8%
336. Transportation Equipment Manufacturing	1,153	10%	266	5%
337. Furniture and Related Product Manufacturing	529	4%	206	4%
339. Miscellaneous Manufacturing	585	5%	267	5%
Total	**12,128**	**100%**	**5,831**	**100%**

Table 44: Frequencies and densities of industries in the population and dataset.

There is no reason to presume a bias in the dataset, as it is in the best interest of Amadeus to provide complete and accurate data. Hence, it is unlikely that the other half of the population not covered by the dataset is systematically different. Furthermore, the correlation coefficient for the industry code in Germany and the dataset is 0.96. As a consequence, the dataset appears to be representative of the relevant population.

4.3 Evaluation of Items and Constructs

4.3.1 Data Preparation

Before analysing the manifest variables, two preliminary steps have to be taken to render the data interpretable. First, SoSciSurvey outputs missing data as “-9”, which statistics software would interpret as a valid number. However, this would lead to a misinterpretation of the data because the answer scale only provides for numbers one to five. There are three ways to deal with this problem:

1. Most statistics software packages include the possibility of marking data entries as missing. For example, in R this is the value “NA” and in Stata it is “.”. While this might work for descriptive statistics, most estimation methods for structural equation models presuppose complete data.

2. The missing values could simply be filled with the average of the other items, which pertain to the same construct. This would seem to be a neutral solution to the problem, but there are difficulties. Items are no longer independent of one another. While high correlation among items is assumed, this procedure would artificially reinforce the effect. Furthermore, if more than one data point is missing from the typical set of four items, half the values would be generated from the other half or worse. However, the sample of 177 responses does not include any such case. Maximum likelihood estimation, which will be used in this dissertation, assumes multivariate normality among manifest variables. Simply filling in the average would bias the data, however slightly, towards multivariate normality because a data point which might otherwise lie at the extreme of the distribution is now forcibly located in the middle. Another objection to the procedure is that while items by design pose very similar questions, they are nevertheless distinct questions. Inferring the response to one question from the

answers given to the other questions might not reflect the respondent's true attitude.

3. Besides a declaratory or mathematical solution, missing values could simply be replaced by "3" which denotes indifference on the answer scale. This would avoid the difficulties associated with the other two procedures, but rely on the assumption that failing to respond to an item means that the respondent is indifferent. After all, if he cannot bring himself to either agree or disagree with the statement, indifference can be inferred.

The third solution will be applied to the data. Within the sample of 177 responses to the 66 items, there are 41 missing values. This amounts to 41 / (177 x 66) = 0.35% of all data points which will be changed to the value "3" instead of "-9".

Second, items Form4, Resp1 and Flex3 pose their statements in a negative fashion, as opposed to the other items which all put forth positive statements. Therefore, the values of these three items have to be reverse coded according the following formula:

$$value = 3 + (3 - value),\ 1 \leq value \leq 5$$

Having applied adaptations to the data, the following sections will provide descriptive statistics of the individual items.

4.3.2 Statistical Tests

There are several statistical tests which can help assess the various items and the constructs they pertain to. The purpose is to ascertain that the items really reflect their construct.

Factor analysis (Hamilton & Stata, 2011, pp. 295-296; Spearman, 1904) seeks to find one or more factors that underly a set of variables. If items load strongly on only one factor, this gives an indication that they pertain to only one construct. The following sections report factor loadings as well as

uniqueness (i.e. the percentage of variance on the individual items not explained by common factors).

A more rigorous test of unidimensionality is suggested by Bagozzi and Yi (2012, pp. 14-16). Confirmatory factor analysis (CFA) tests the hypotheses that the items have only one underlying factor. In order to decide whether or not to reject this hypotheses, there are several goodness-of-fit-indices. The authors recommend the χ^2 statistic, the root mean squared error of approximation (RMSEA), the comparative fit index (CFI), the Tucker-Lewis index (TLI) and the standardised root mean squared residual (SRMR) (Bagozzi & Yi, Youjae, 2012, pp. 28-29). The table of fit indices for the constructs in appendix A7 also includes the coefficient of determination (CD), which is provided as an additional index by Stata. This variety of goodness-of-fit indices allows to better judge unidemensionality.

Cronbach's α (Cronbach, 1951; Hamilton & Stata, 2011, p. 12) measures the reliability of items. Because the reliability is calculated under the assumption of one common factor, this test requires that the items pertain only to one factor. The average inter-item correlation is also reported as an additional indication of reliability.

4.3.3 Antecedents

The following sections describe items pertaining to the nine antecedents of Information Quality and System Quality.

4.3.3.1 Accuracy

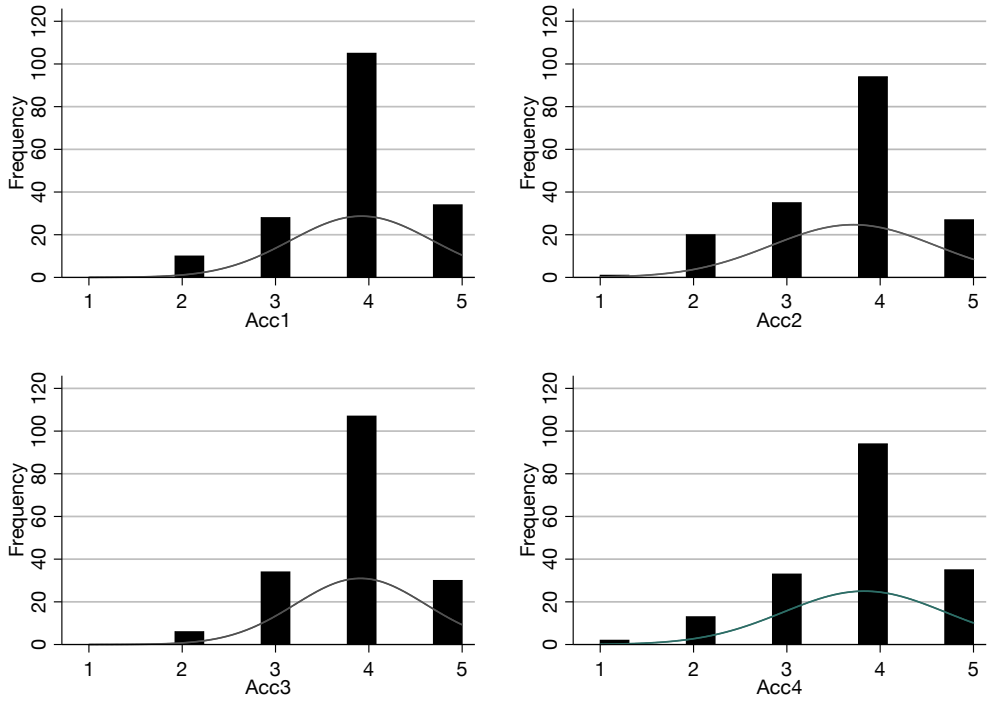


Figure 27: Frequency distributions of items pertaining to Accuracy.
With superimposed normal distributions.

The four items Acc1, Acc2, Acc3 and Acc4 show similar frequency distributions with "4" being the most common response. They all exhibit skewness but no kurtosis (see appendix A5). The null hypothesis of non-normality cannot be rejected for either of the items.

Respondents show general disagreement with statements that their information system provides them with accurate information. Only a small portion agree with a statement and almost none agree fully.

A factor analysis (see table 45) of the four items shows that they all load strongly onto one factor and only weakly onto a second factor. The CFA does not reject the hypothesis of a single underlying factor based on all goodness-of-fit indices except for χ^2 (see appendix A7). Cronbach's α is 0.855 with an average inter-item correlation of 0.5959 (see appendix A8). These tests suggest that the items reflect the construct Accuracy.

	Factor 1	Factor 2	Uniqueness
Acc1	0.8146	-0.0248	0.3358
Acc2	0.7516	-0.0360	0.4339
Acc3	0.7818	0.0260	0.3882
Acc4	0.6822	0.0395	0.5330

Table 45: Factor analysis of items pertaining to Accuracy.

4.3.3.2 Completeness

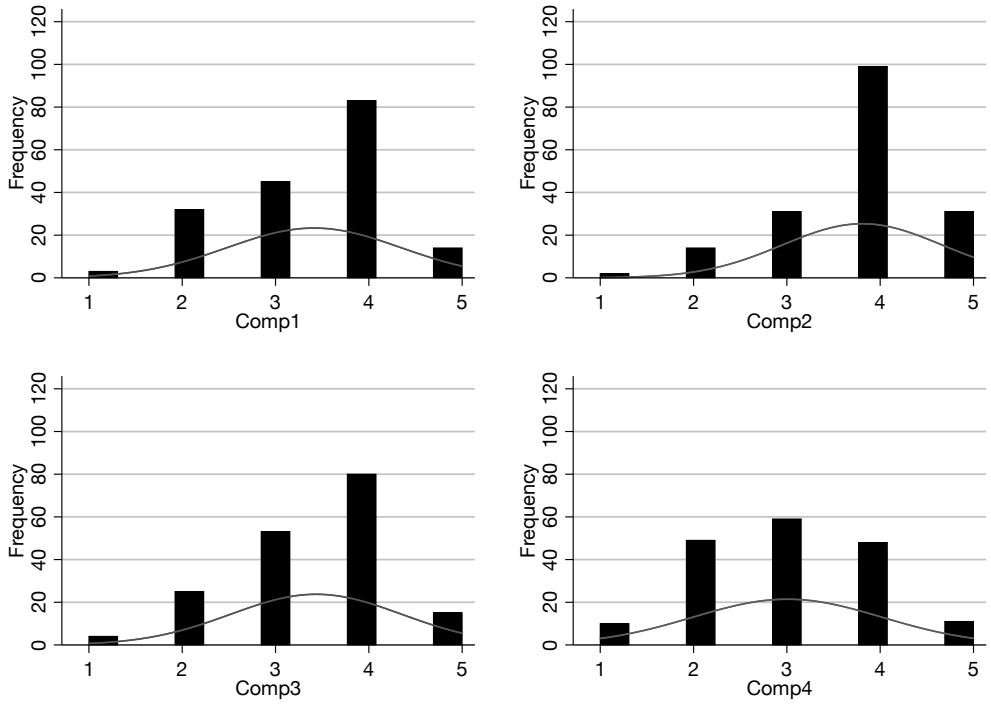


Figure 28: Frequency distributions of items pertaining to Completeness. With superimposed normal distributions.

The three items Comp1, Comp2 and Comp3 show similar frequency distributions with increasing frequency for responses “2” to “4”. Item Comp4 is more equally distributed. The first three exhibit skewness but no kurtosis, whereas the fourth item exhibits kurtosis but no skewness (see appendix A5). The null hypothesis of non-normality cannot be rejected for either of the items.

Respondents tend to disagree with statements that their information system provides them with complete information. However, the summarising question in Comp4 receives about as much agreement as disagreement. But still the largest portion of respondents indicate indifference.

A factor analysis (see table 46) of the four items shows that they all load strongly onto a single factor. The CFA does not reject the hypothesis of a single underlying factor based on all goodness-of-fit indices (see appendix A7). Cronbach's α is 0.8305 with an average inter-item correlation of 0.5506 (see appendix A8). These tests suggest that the items reflect the construct Completeness.

	Factor 1	**Uniqueness**
Comp1	0.8057	0.3509
Comp2	0.6685	0.5531
Comp3	0.7342	0.4610
Comp4	0.6914	0.5220

Table 46: Factor analysis of items pertaining to Completeness.

4.3.3.3 Currency

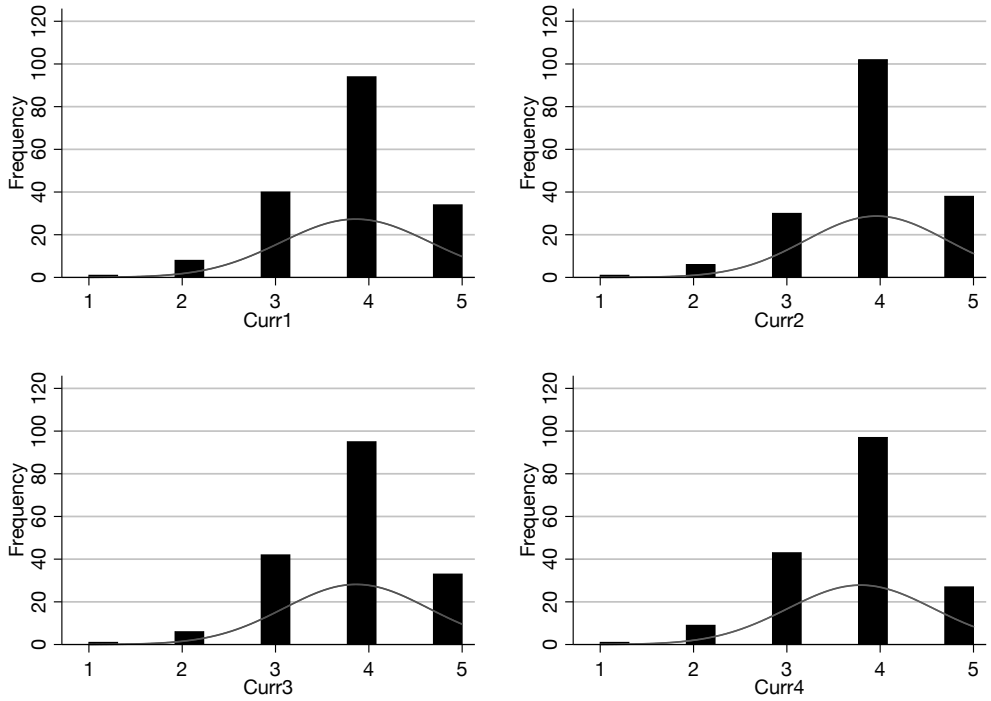


Figure 29: Frequency distributions of items pertaining to Currency.
With superimposed normal distributions.

The four items Curr1, Curr2, Curr3 and Curr4 show similar frequency distributions with "4" being the most common response. They all exhibit skewness but no kurtosis, except for Curr2 (see appendix A5). The null hypothesis of non-normality cannot be rejected for either of the items.

Respondents show general disagreement with statements that their information system provides them with current information. The total numbers indicating their agreement or even full agreement are very low by comparison.

A factor analysis (see table 47) of the four items shows that they all load strongly onto one factor and only weakly onto a second factor. The CFA does not reject the hypothesis of a single underlying factor based on all goodness-of-fit indices except for χ^2 (see appendix A7). Cronbach's α is 0.8575 with an average inter-item correlation of 0.6007 (see appendix A8). These tests suggest that the items reflect the construct Currency.

	Factor 1	Factor 2	Uniqueness
Curr1	0.7532	-0.2256	0.3818
Curr2	0.7773	-0.0785	0.3896
Curr3	0.7189	0.2373	0.4269
Curr4	0.8241	0.0733	0.3155

Table 47: Factor analysis of items pertaining to Currency.

4.3.3.4 Format

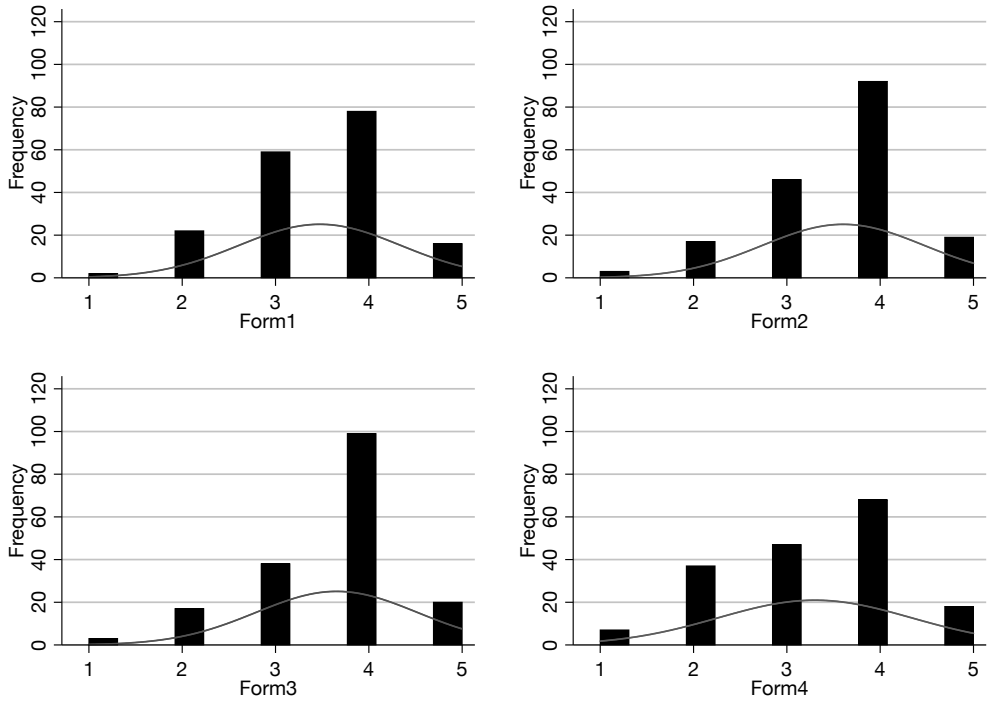


Figure 30: Frequency distributions of items pertaining to Format.
With superimposed normal distributions.

The four items Form1, Form2, Form3 and Form4 show similar frequency distributions with "4" being the most common response. The null hypothesis of non-normality has to be rejected for Form1, but cannot be rejected for the other three items. They exhibit either skewness (Form2 and Form3) or kurtosis (Form4). See appendix A5 for the exact values.

Respondents show general disagreement with statements that their information system provides them with well-formatted information. Answer "3", which denotes indifference, is also indicated frequently. Nevertheless, the summarising question in Form4 receives only slightly more disagreement than agreement.

A factor analysis (see table 48) of the four items shows that they all load strongly onto one factor and only weakly onto a second factor. Item Form4 loads less strongly onto the first factor than the other items, but still much stronger than onto the second factor. The CFA does not reject the hypothesis of a single underlying factor based on all goodness-of-fit indices (see appendix A7). Cronbach's α is 0.8151 with an average inter-item correlation of 0.5243 (see appendix A8). These tests suggest that the items reflect the construct Format.

	Factor 1	**Factor 2**	**Uniqueness**
Form1	0.8353	0.0379	0.3008
Form2	0.8611	-0.0238	0.2579
Form3	0.7668	-0.0970	0.4026
Form4	0.4138	0.1526	0.8055

Table 48: Factor analysis of items pertaining to Format.

4.3.3.5 Accessibility

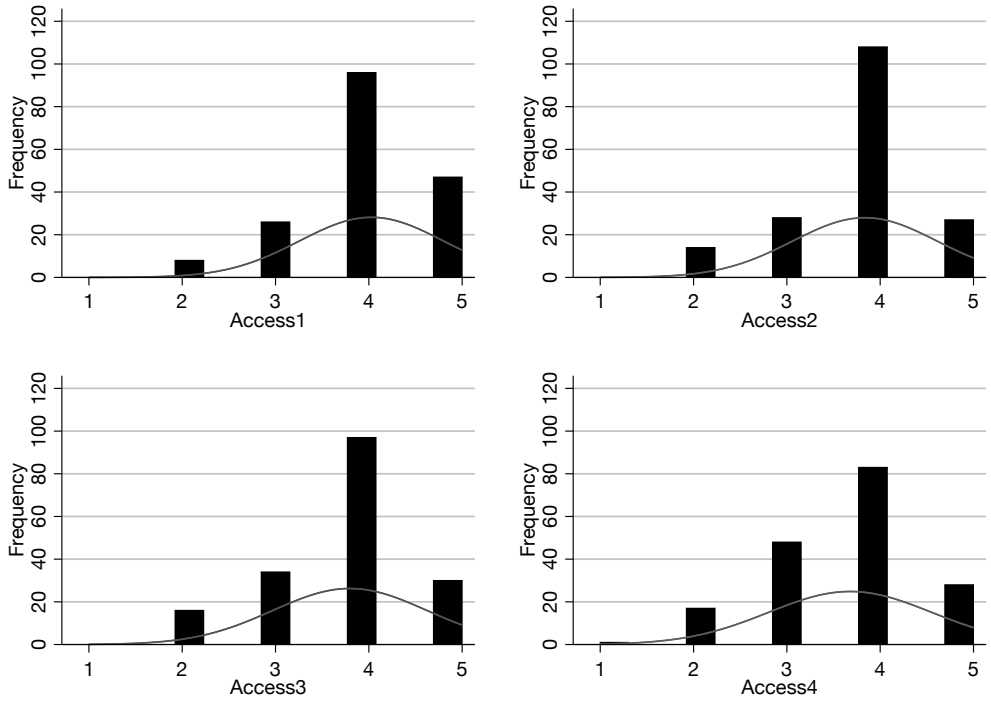


Figure 31: Frequency distributions of items pertaining to Accessibility.
With superimposed normal distributions.

The four items Access1, Access2, Access3 and Access4 show similar frequency distributions with "4" being the most common response. They all exhibit skewness but no kurtosis (see appendix A5). The null hypothesis of non-normality can only be rejected for item Access4.

Respondents show general disagreement with statements that the information in the information system is easily accessible to them.

A factor analysis (see table 49) of the four items shows that they all load strongly onto one factor and only weakly onto a second factor. The CFA does not reject the hypothesis of a single underlying factor based on all goodness-of-fit indices except for χ^2 (see appendix A7). Cronbach's α is 0.881 with an average inter-item correlation of 0.6492 (see appendix A8). These tests suggest that the items reflect the construct Completeness.

	Factor 1	Factor 2	Uniqueness
Access1	0.7087	0.0668	0.4933
Access2	0.7761	0.0466	0.3956
Access3	0.8530	-0.0550	0.2694
Access4	0.8447	-0.0433	0.2846

Table 49: Factor analysis of items pertaining to Accessibility.

4.3.3.6 Reliability

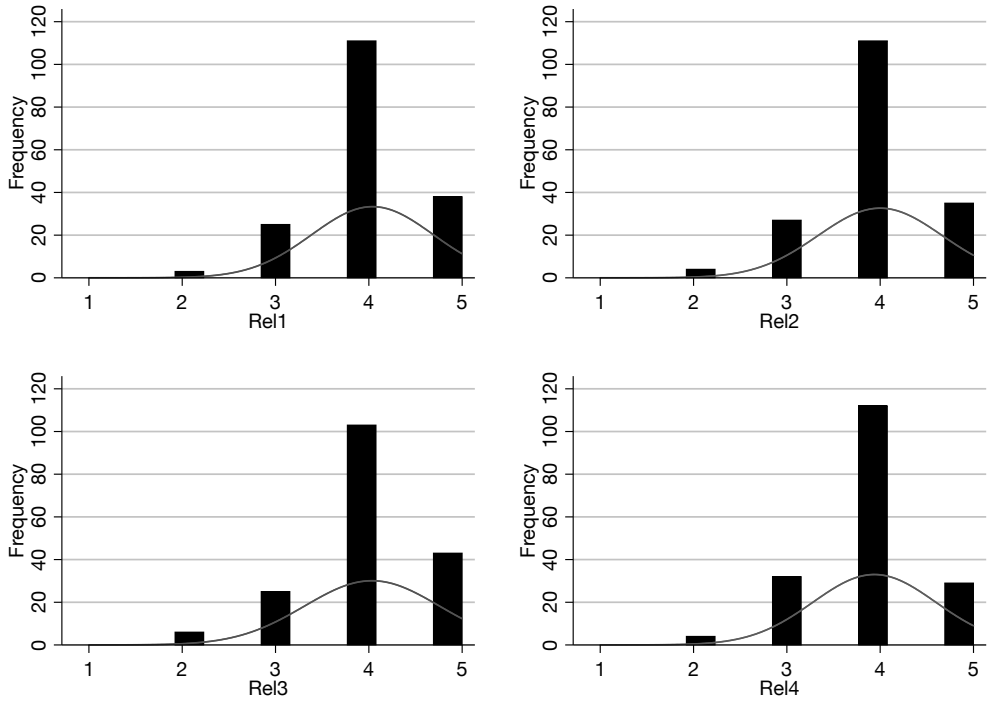


Figure 32: Frequency distributions of items pertaining to Reliability.
With superimposed normal distributions.

The four items Rel1, Rel2, Rel3 and Rel4 show similar frequency distributions with "4" being the most common response. They all exhibit skewness but no kurtosis (see appendix A5). The null hypothesis of non-normality cannot be rejected for either of the items.

Respondents show general disagreement with statements that their information system operates in a reliable fashion.

A factor analysis (see table 50) of the four items shows that they all load strongly onto a single factor. The CFA does not reject the hypothesis of a single underlying factor based on all goodness-of-fit indices (see appendix A7). Cronbach's α is 0.918 with an average inter-item correlation of 0.3358 (see appendix A8). These tests suggest that the items reflect the construct Reliability.

	Factor 1	**Uniqueness**
Rel1	0.8792	0.2270
Rel2	0.8485	0.2800
Rel3	0.8489	0.2794
Rel4	0.8185	0.3300

Table 50: Factor analysis of items pertaining to Reliability.

4.3.3.7 Response Time

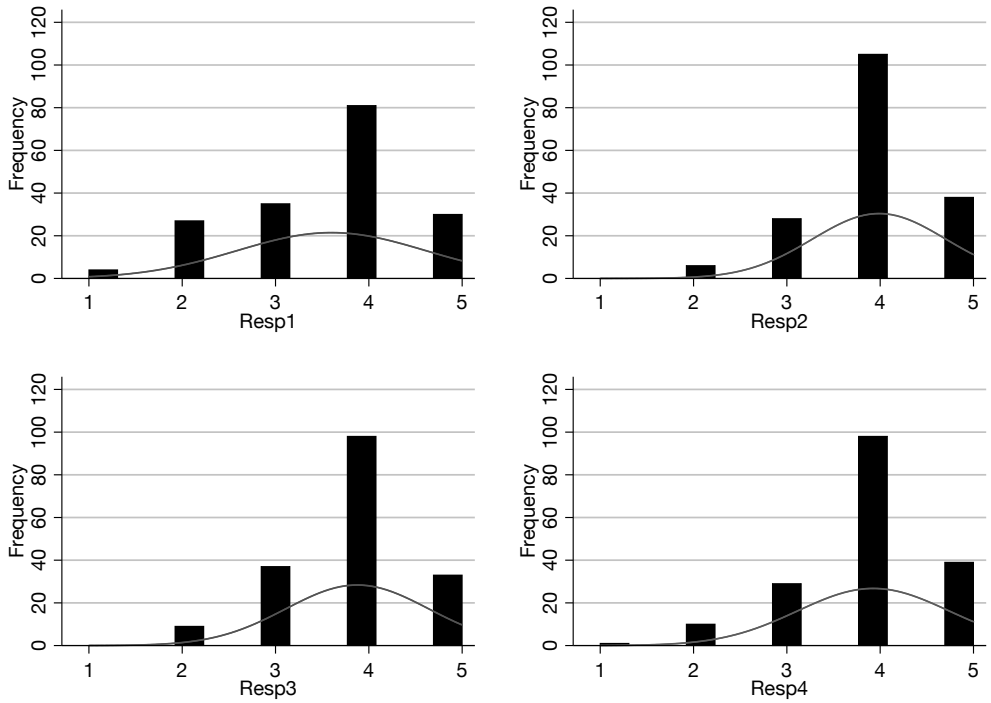


Figure 33: Frequency distributions of items pertaining to Response Time. With superimposed normal distributions.

The four items Resp1, Resp2, Resp3 and Resp4 show similar frequency distributions with "4" being the most common response. They all exhibit skewness but no kurtosis (see appendix A5). The null hypothesis of non-normality cannot be rejected for either of the items.

Respondents show general disagreement with statements that their information system responds to requests quickly. However, compared to the other three items, Resp1 shows a larger portion of agreement.

A factor analysis (see table 51) of the four items shows that they all load strongly onto one factor and only weakly onto a second factor. Item Resp1 loads less strongly onto the first factor than the other items, but still much stronger than onto the second factor. The CFA does not reject the hypothesis of a single underlying factor based on all goodness-of-fit indices (see appendix A7). Cronbach's α is 0.8102 with an average inter-item correlation of 0.5163 (see appendix A8). These tests suggest that the items reflect the construct Response Time.

	Factor 1	**Factor 2**	**Uniqueness**
Resp1	0.5664	0.1722	0.6495
Resp2	0.6531	-0.1644	0.5464
Resp3	0.8547	-0.0092	0.2694
Resp4	0.7595	0.0233	0.4226

Table 51: Factor analysis of items pertaining to Response Time.

4.3.3.8 Flexibility

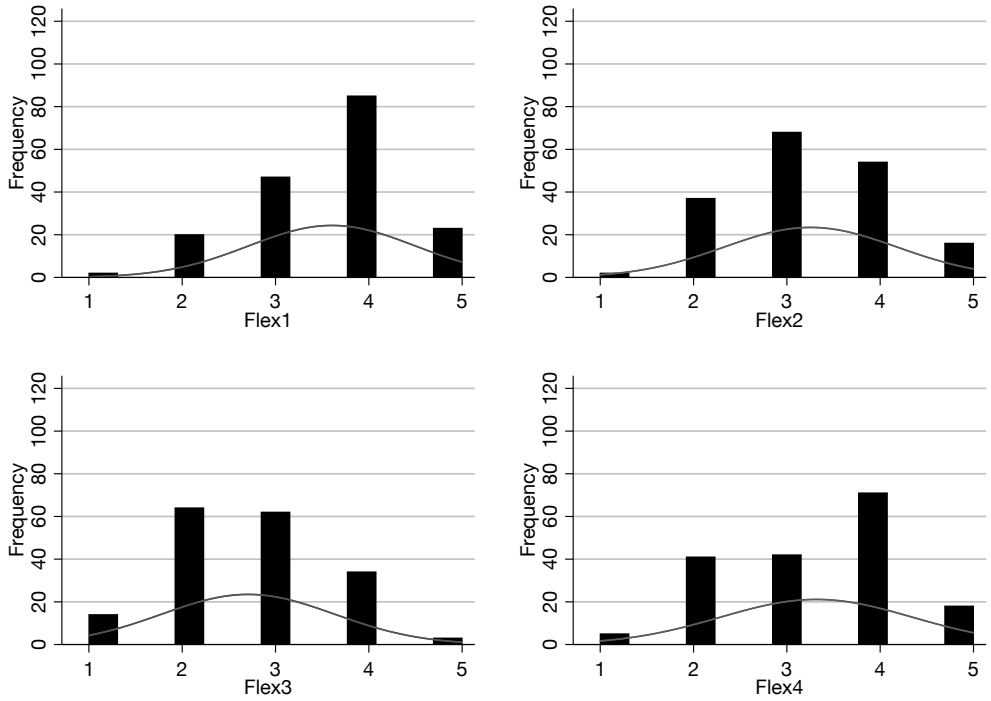


Figure 34: Frequency distributions of items pertaining to Flexibility.
With superimposed normal distributions.

The four items Access1, Access2, Access3 and Access4 show mixed frequency distributions. While the most common response for items Flex1 und Flex4 is “4”, the second item shows more evenly distributed results. Item Flex3 evinces “2” as the most frequent response, closely followed by “3”. Skewness is present in the second, third and fourth item, whereas the first item exhibits only kurtosis. The null hypothesis of non-normality can only be rejected for Flex3. See appendix A5 for the exact values.

Respondents tend to disagree with statements that the information system is flexible. The only exception is item Flex3 where respondents indicate either agreement or indifference.

A factor analysis (see table 52) of the four items shows that they all load strongly onto one factor and only weakly onto a second factor. Item Flex4 loads less strongly onto the first factor than the other items, but still much stronger than onto the second factor. The CFA does not reject the

hypothesis of a single underlying factor based on all goodness-of-fit indices (see appendix A7). Cronbach's α is 0.7824 with an average inter-item correlation of 0.4734 (see appendix A8). These tests suggest that the items reflect the construct Flexibility.

	Factor 1	**Factor 2**	**Uniqueness**
Flex1	0.7502	-0.0034	0.4373
Flex2	0.8485	0.0706	0.2751
Flex3	-0.8550	0.0135	0.2688
Flex4	-0.2985	0.1534	0.8873

Table 52: Factor analysis of items pertaining to Flexibility.

4.3.3.9 Integration

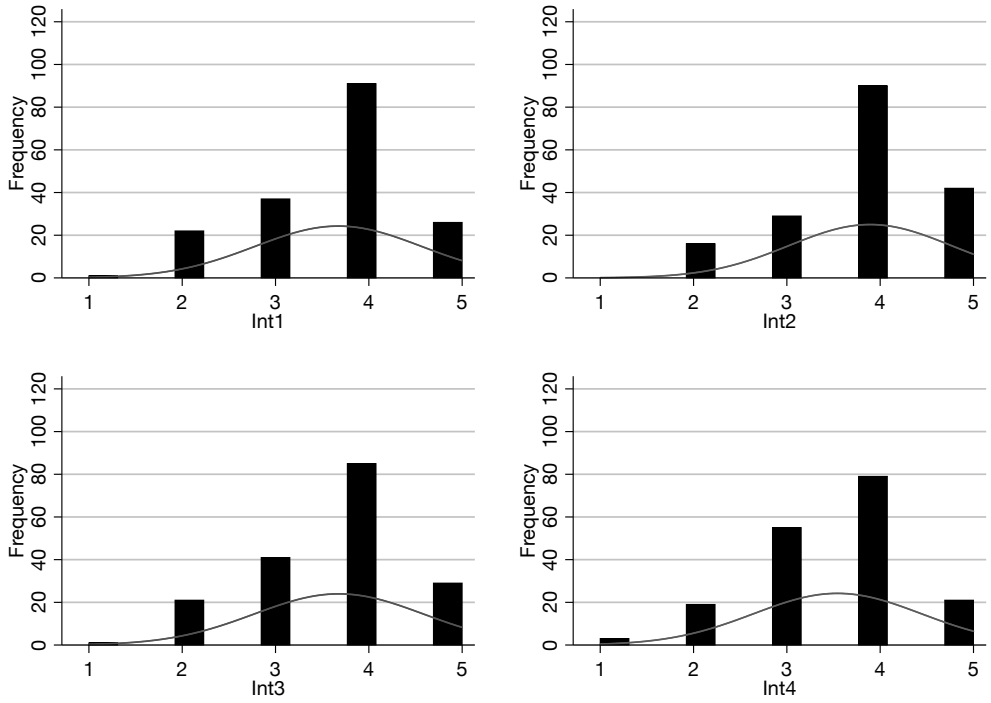


Figure 35: Frequency distributions of items pertaining to Integration.
With superimposed normal distributions.

The four items Int1, Int2, Int3 and Int4 show similar frequency distributions with "4" being the most common response. They all exhibit skewness but no

kurtosis (see appendix A5). The null hypothesis of non-normality can only be rejected for Int4, but not for the other items.

Respondents show general disagreement with statements that their information system integrates well with other systems.

A factor analysis (see table 53) of the four items shows that they all load strongly onto a single factor. The CFA does not reject the hypothesis of a single underlying factor based on all goodness-of-fit indices (see appendix A7). Cronbach's α is 0.8882 with an average inter-item correlation of 0.6651 (see appendix A8). These tests suggest that the items reflect the construct Integration.

	Factor 1	**Uniqueness**
Int1	0.8851	0.2166
Int2	0.7480	0.4406
Int3	0.8975	0.1945
Int4	0.6953	0.5166

Table 53: Factor analysis of items pertaining to Integration.

4.3.4 DeLone & McLean Variables

The following sections describe the items pertaining to the four items derived and adapted from the DeLone and McLean model of IS success.

4.3.4.1 Information Quality

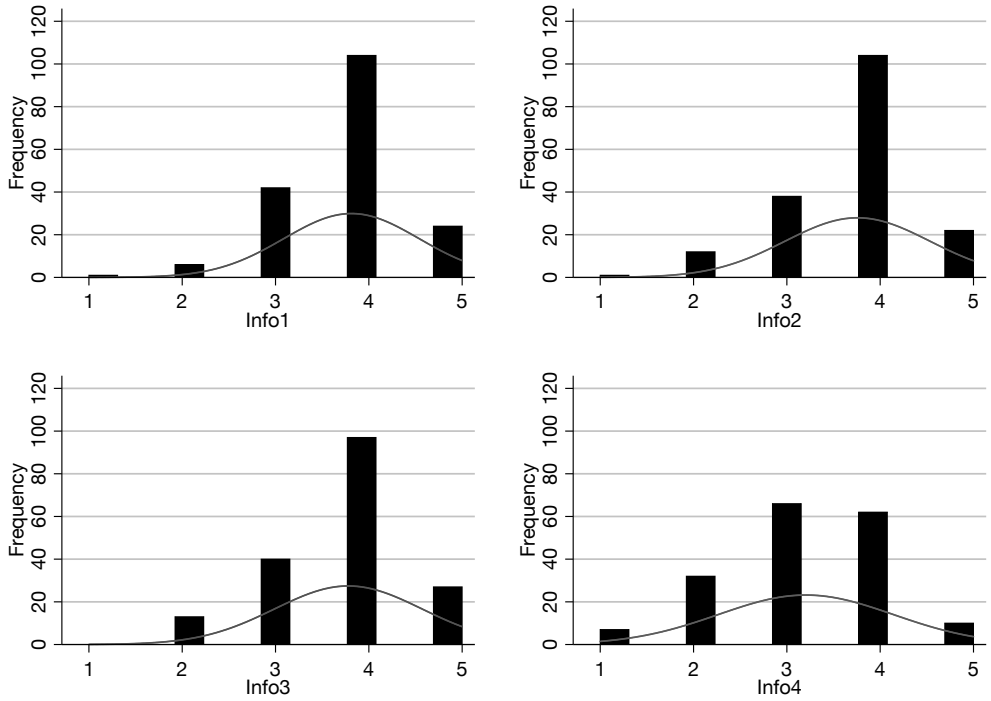


Figure 36: Frequency distributions of items pertaining to Information Quality. With superimposed normal distributions.

The three items Info1, Info2 and Info3 show similar frequency distributions with “4” being the most common response. For item Info4, “3” is the most common response, closely followed by “4”. Info1 exhibits both skewness and kurtosis, whereas items Info2 and Info3 only exhibit skewness. Info4 shows neither skewness nor kurtosis and is the only item of the four for which the null hypothesis of non-normality can be rejected. See appendix A5 for the exact values.

Respondents show general disagreement with statements that the information provided by their information system is of good quality. Only responses to item Info4 indicate slightly more indifference than disagreement.

A factor analysis (see table 54) of the four items shows that they all load strongly onto a single factor. The CFA does not reject the hypothesis of a single underlying factor based on all goodness-of-fit indices (see appendix

A7). Cronbach's α is 0.8662 with an average inter-item correlation of 0.6181 (see appendix A8). These tests suggest that the items reflect the construct Information Quality.

	Factor 1	**Uniqueness**
Info1	0.8520	0.2741
Info2	0.8477	0.2814
Info3	0.7982	0.3630
Info4	0.6053	0.6336

Table 54: Factor analysis of items pertaining to Information Quality.

4.3.4.2 System Quality

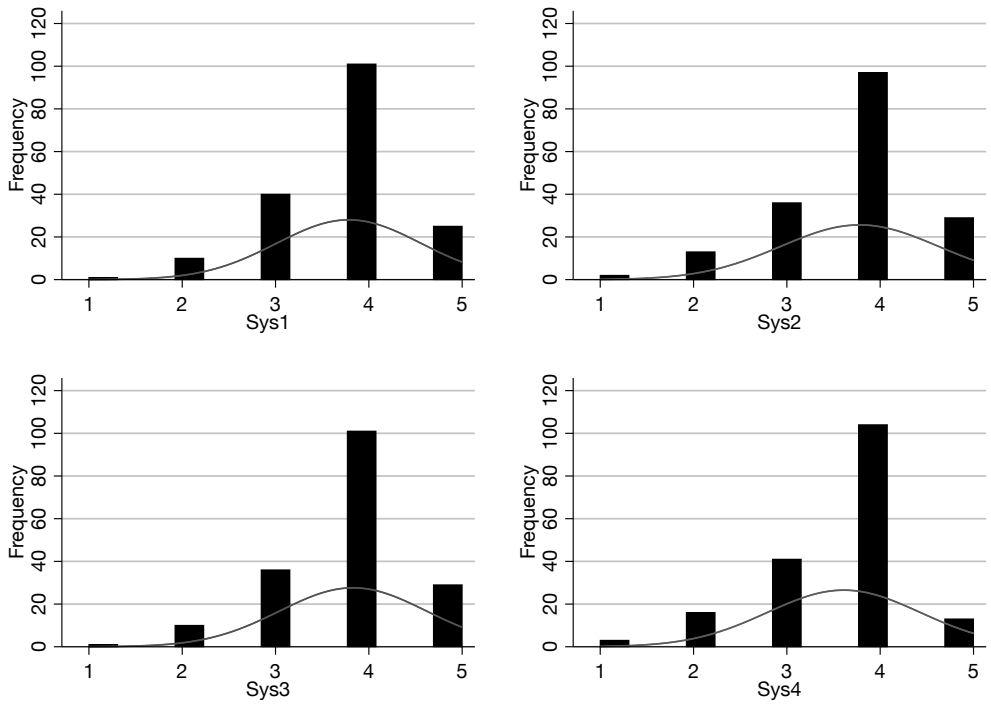


Figure 37: Frequency distributions of items pertaining to System Quality. With superimposed normal distributions.

The four items Sys1, Sys2, Sys3 and Sys4 show similar frequency distributions with "4" being the most common response. They are all skewed, but in addition, item Sys4 also exhibits kurtosis. The null hypothesis of non-

normality cannot be rejected for either of the items. See appendix A5 for the exact values.

Respondents show general disagreement with statements that the quality of their information system is good.

A factor analysis (see table 55) of the four items shows that they all load strongly onto a single factor. The CFA does not reject the hypothesis of a single underlying factor based on all goodness-of-fit indices (see appendix A7). Cronbach's α is 0.9163 with an average inter-item correlation of 0.7324 (see appendix A8). These tests suggest that the items reflect the construct System Quality.

	Factor 1	**Uniqueness**
Sys1	0.8509	0.2759
Sys2	0.9091	0.1735
Sys3	0.8790	0.2273
Sys4	0.7509	0.4362

Table 55: Factor analysis of items pertaining to System Quality.

4.3.4.3 Perceived Usefulness

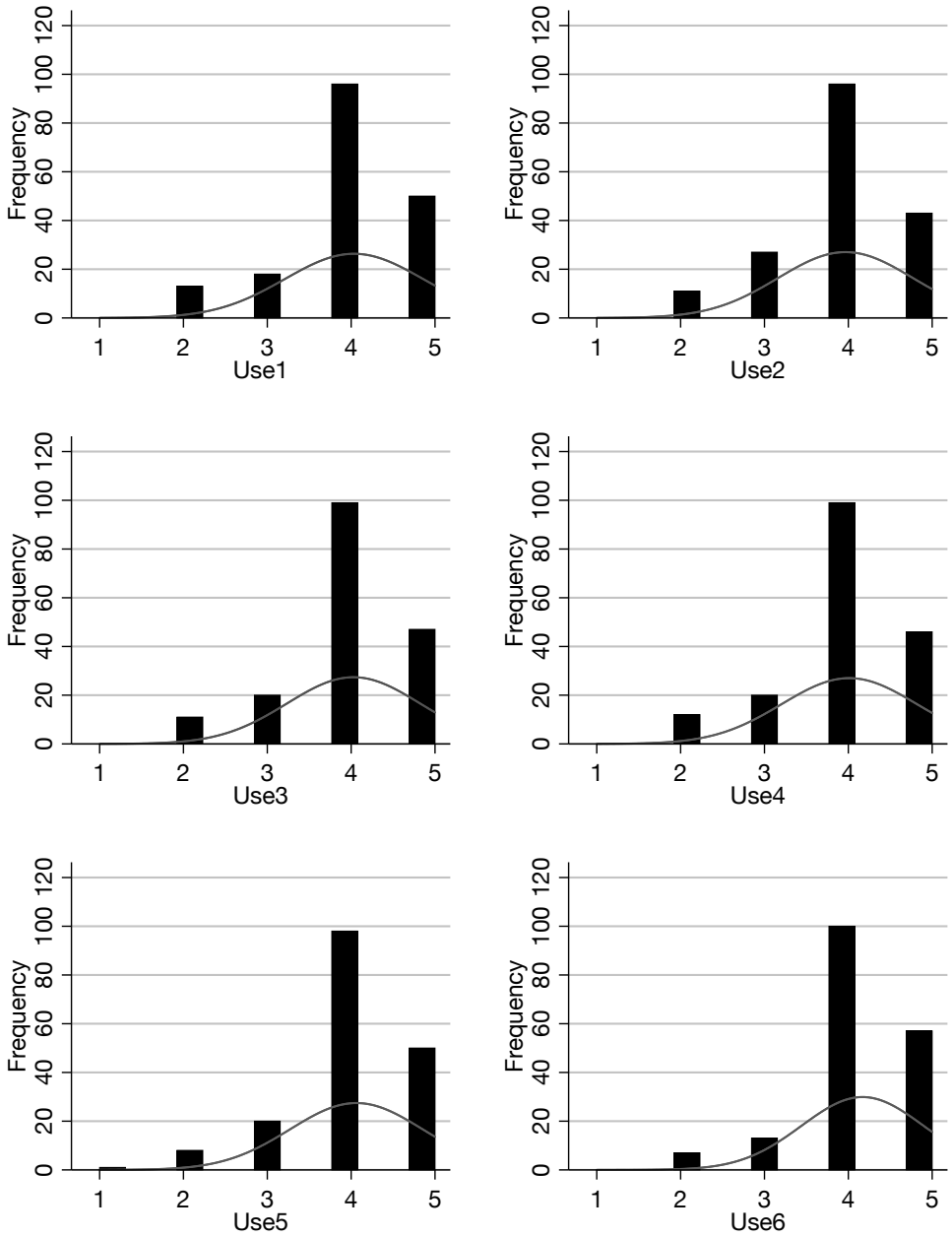


Figure 38: Frequency distributions of items pertaining to Perceived Usefulness. With superimposed normal distributions.

The six items Use1, Use2, Use3, Use4, Use5 and Use6 show similar frequency distributions with “4” being the most common response followed by “5”. They are all skewed, but in addition, items Use5 and Use6 exhibit kurtosis. The null hypothesis of non-normality cannot be rejected for either of the items. See appendix A5 for the exact values.

Respondents show general disagreement with statements that they perceive the information system as being useful for their jobs.

A factor analysis (see table 56) of the six items shows that they all load strongly onto one factor and only weakly onto a second and third factor. The CFA does not reject the hypothesis of a single underlying factor based on all goodness-of-fit indices except for χ^2 (see appendix A7). Cronbach's α is 0.956 with an average inter-item correlation of 0.7835 (see appendix A8). These tests suggest that the items reflect the construct Perceived Usefulness.

	Factor 1	**Factor 2**	**Factor 3**	**Uniqueness**
Use1	0.8415	0.0134	0.1055	0.2806
Use2	0.8445	0.1385	0.0406	0.2660
Use3	0.9317	0.0553	-0.0752	0.1231
Use4	0.9151	0.0071	-0.0802	0.1561
Use5	0.8747	-0.1106	-0.0004	0.2227
Use6	0.8906	-0.1006	0.0233	0.1962

Table 56: Factor analysis of items pertaining to Perceived Usefulness.

4.3.4.4 Satisfaction

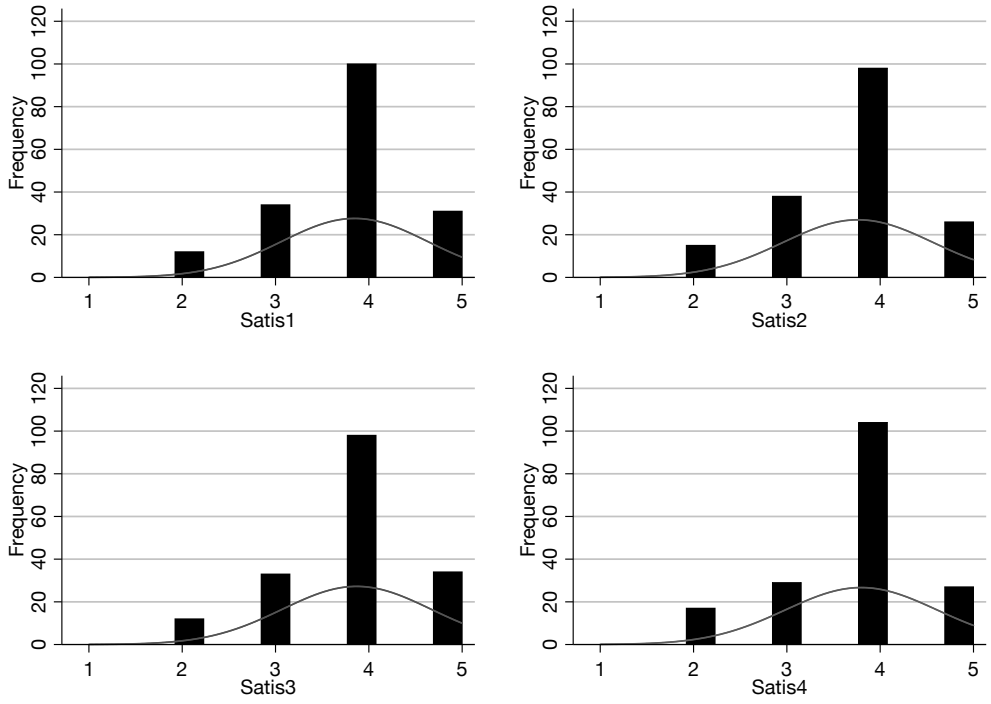


Figure 39: Frequency distributions of items pertaining to Satisfaction.
With superimposed normal distributions.

The four items Satis1, Satis2, Satis3 and Satis4 show similar frequency distributions with “4” being the most common response. They all exhibit skewness but no kurtosis (see appendix A5). The null hypothesis of non-normality cannot be rejected for either of the items.

Respondents show general disagreement with statements that they are satisfied with their information system.

A factor analysis (see table 57) of the four items shows that they all load strongly onto a single factor. The CFA does not reject the hypothesis of a single underlying factor based on all goodness-of-fit indices (see appendix A7). Cronbach’s α is 0.9062 with an average inter-item correlation of 0.7072 (see appendix A8). These tests suggest that the items reflect the construct Satisfaction.

	Factor 1	Uniqueness
Satis1	0.8251	0.3191
Satis2	0.8256	0.3183
Satis3	0.8500	0.2776
Satis4	0.8149	0.3360

Table 57: Factor analysis of items pertaining to Satisfaction.

4.3.5 Net Benefits

The following sections describe the items pertaining to the three benefits of managerial accounting for SMEs.

4.3.5.1 Cost Savings

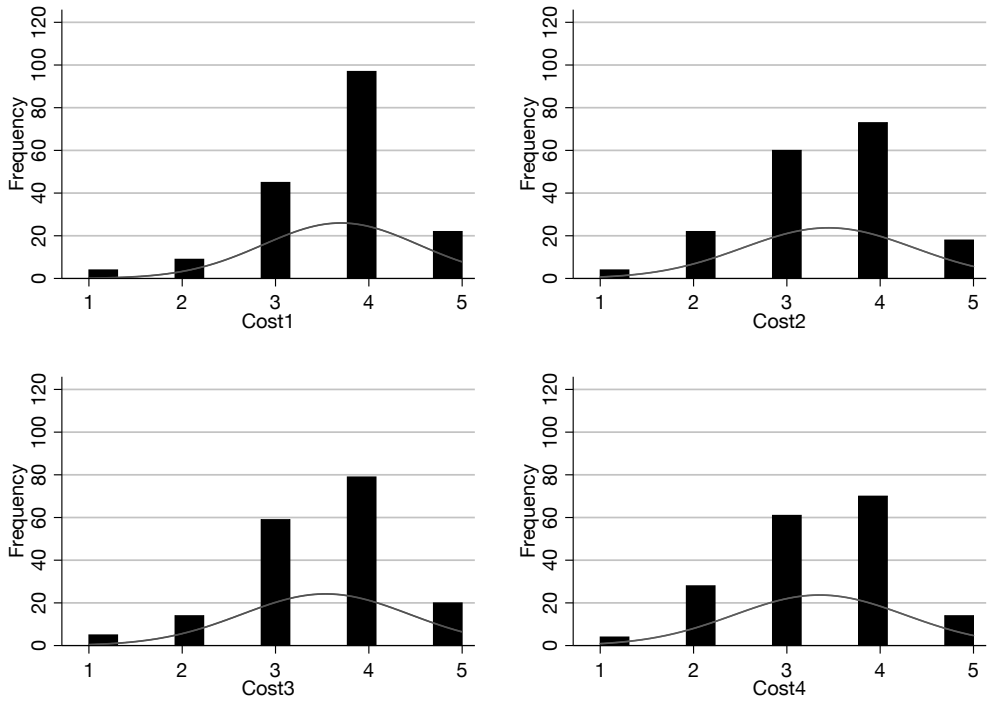


Figure 40: Frequency distributions of items pertaining to Cost Savings.
With superimposed normal distributions.

The four items Cost1, Cost2, Cost3 and Cost4 show similiar frequency distributions with “4” being the most common response. Cost1 is both

skewed and shows kurtosis. Items Cost2 and Cost3 exhibit skewness but no kurtosis. By contrast, item Cost4 is neither skewed nor shows kurtosis and thus it is the only item of the four for which the null hypothesis of non-normality can be rejected. See appendix A5 for the exact values.

Respondents show general disagreement with statements that using their information system results in cost savings for their company.

A factor analysis (see table 58) of the four items shows that they all load strongly onto a single factor. The CFA does not reject the hypothesis of a single underlying factor based on all goodness-of-fit indices (see appendix A7).Cronbach's α is 0.8169 with an average inter-item correlation of 0.5272 (see appendix A8). These tests suggest that the items reflect the construct Cost Savings.

	Factor 1	**Uniqueness**
Cost1	0.7093	0.4970
Cost2	0.7787	0.3936
Cost3	0.6330	0.5993
Cost4	0.7071	0.5000

Table 58: Factor analysis of items pertaining to Cost Savings.

4.3.5.2 Better Cooperation

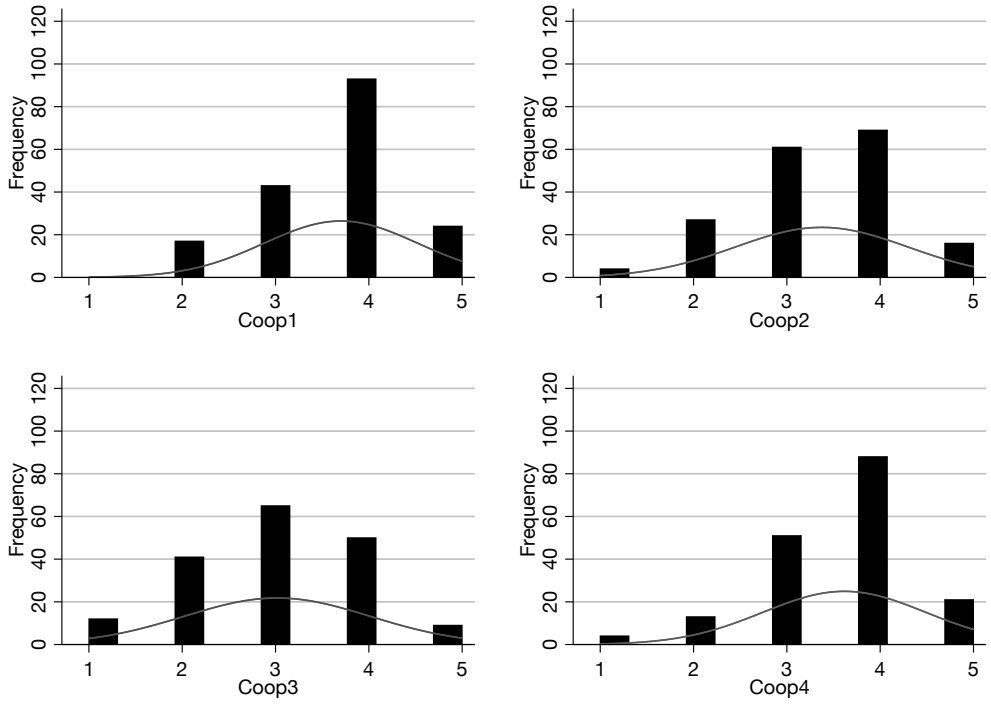


Figure 41: Frequency distributions of items pertaining to Better Cooperation. With superimposed normal distributions.

The three items Coop1, Coop2 and Coop4 show similar frequency distributions with “4” being the most common response. For item Coop3, “3” is the most common response, closely followed by “4”. Items Coop2 and Coop3 exhibit neither skewness nor kurtosis. For them, the null hypothesis of non-normality can be rejected. The same is true for item Coop1, even though it is skewed. Normality cannot be assumed for item Coop4, which is also skewed. See appendix A5 for the exact values.

Respondents show general disagreement with statements that using their information improves the cooperation among employees.

A factor analysis (see table 59) of the four items shows that they all load strongly onto one factor and only weakly onto a second factor. Item Coop3 loads less strongly onto the first factor than the other items, but still much stronger than onto the second factor. The CFA does not reject the hypothesis of a single underlying factor based on all goodness-of-fit indices

except for χ^2 (see appendix A7). Cronbach's α is 0.8205 with an average inter-item correlation of 0.5334 (see appendix A8). These tests suggest that the items reflect the construct Better Cooperation.

	Factor 1	**Factor 2**	**Uniqueness**
Coop1	0.7797	-0.0673	0.3876
Coop2	0.8265	0.0621	0.3130
Coop3	0.5015	0.2055	0.7063
Coop4	0.7773	-0.1311	0.3785

Table 59: Factor analysis of items pertaining to Better Cooperation.

4.3.5.3 Reduced Uncertainty

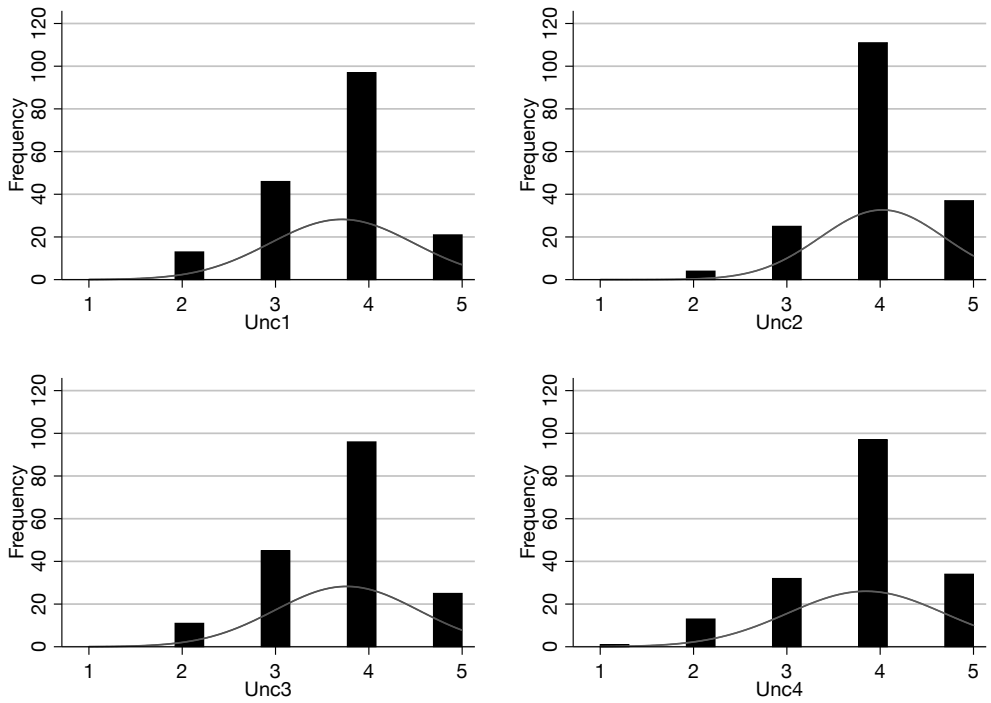


Figure 42: Frequency distributions of items pertaining to Reduced Uncertainty. With superimposed normal distributions.

The four items Unc1, Unc2, Unc3 and Unc4 show similar frequency distributions with "4" being the most common response. They are all skewed,

but do not exhibit kurtosis. The null hypothesis of non-normality can only be rejected for items Unc1 and Unc3. See appendix A4 for the exact values.

Respondents show general disagreement with statements that using their information systems enables them to reduce the environmental uncertainty in which their company operates.

A factor analysis (see table 60) of the four items shows that they all load strongly onto a single factor. The CFA does not reject the hypothesis of a single underlying factor based on all goodness-of-fit indices except for χ^2 (see appendix A7). Cronbach's α is 0.7562 with an average inter-item correlation of 0.4368 (see appendix A8). These tests suggest that the items reflect the construct Reduced Uncertainty.

	Factor 1	**Factor 2**	**Uniqueness**
Unc1	0.6216	-0.1084	0.6019
Unc2	0.7152	0.0796	0.4822
Unc3	0.6649	-0.1166	0.5443
Unc4	0.5677	0.1549	0.6537

Table 60: Factor analysis of items pertaining to Reduced Uncertainty.

4.4 Parameter Estimation

4.4.1 Estimation Method

There are different mathematical methods for estimating the parameters in a structrual equation model. For LISREL, the three most common methods are maximum likelihood (ML), generalised least square (GLS) and asymptotic distribution free (ADF). (Anderson & Gerbing, 1988, p. 413; Chou & Bentler, 1995, p. 38; Gefen et al., 2000, p. 28; Mueller, 1996, p. 151) ML and GLS are similar in their estimation procedure to the point that they are "asymptotically equivalent" (Mueller, 1996, p. 153). This means that the difference in estimates approaches zero for large samples. Another similarity is the

assumption of a multivariate-normal distribtion of manifest variables. (Jöreskog, 1973, pp. 105-106; West, Stephen G., Finch, John F., & Curran, Patrick J., 1995, pp. 56-57) As the name suggests, ADF does not require the data to follow a normal distribution. ML is the most widely investigated method of the three and appears to yield reliable results even when the underlying assumptions are violated. (Chou & Bentler, 1995, pp. 38-39) For these reasons, the estimation of the parameters in the research model will use the ML aproach.

The mathematical rationale behind ML is best expressed by Fornell (1982, p. 442): “In ML estimation, the probability of the observed data given the hypothesized model is maximized.” In practice, the algorithm seeks “to minimize the differnce between the population covariance matrix, Σ, as estimated by the sample covariance matrix, S, and the covariance matrix derived from the hypothesized model, Σ(Θ).” (Chou & Bentler, 1995, p. 44) This fitting function for ML is expressed as:

$F_{ML} = \log|\Sigma(\Theta)| + \text{Trace}[\Sigma(\Theta)^{-1}S] - \log|S| - p$, where p equals the number of variables in the covariance matrix. (cf. Chou & Bentler, 1995, p. 45; Jöreskog, 1969, pp. 184-185; Mueller, 1996, pp. 152-155)

4.4.2 Underlying Assumptions

ML estimation makes two basic underlying assumptions (West, Stephen G. et al., 1995, p. 56):

1. Manifest variables are continuous.
2. Manifest variable are multivariate normally distributed.

The first assumption is violated by the very research design of using a five-point Likert scale to measure responses. A continuous scale would have been quite impractical both technically and conceptually. While the Likert scale measures attitudes, miniscule or infinitissmal differences in responses could harldy have a meaningful interpretation. Forcing participants to choose one of five categories ensures that repsonses are at least somewhat

comparable. From a technical perspective, even the use of a slider tool restricts a continuous measurement to the number of pixels from one end of the slider to the other. The use of discrete manifest variables is an advantage in measurement, but a disadvantage in estimation.

The second assumption is violated as well. No group of manifest variables pertaining to a construct shows a multivariate normal distribution. In fact, there are only eight cases where two items are bivariate normal. See table 61 below for the exact values. This finding is consistent with the lack of univariate normality in most of the items, as reported in section 4.3. (West, Stephen G. et al., 1995, pp. 60-61)

Table 61 reports the degrees of freedom, the Mardia test statistic for skewness and kurtosis (Mardia, 1970), the Henze-Zirkler test of multivariate normality (Henze & Zirkler, 1990) and the Doornik-Hansen omnibus test for multivariate normality (Doornik, Jurgen A. & Hansen, Henrik, 2008).

		Original			Transformed		
	df	**Value**	**X^2**	**Pr > X^2**	**Value**	**X^2**	**Pr > X^2**
Accuracy							
Skewness	20	3.4955	105.576	0.0000	1.7498	52.850	0.0001
Kurtosis	1	34.5458	102.525	0.0000	30.7316	41.774	0.0000
Henze-Zirkler	1	13.0702	582.095	0.0000	13.0877	582.663	0.0000
Doornik-Hansen	8		53.232	0.0000		6.980	0.5388
Completeness							
Skewness	20	2.2658	68.435	0.0000	1.3001	39.269	0.0062
Kurtosis	1	28.3470	17.420	0.0000	24.9506	0.833	0.3614
Henze-Zirkler	1	2.7698	110.069	0.0000	3.0620	129.342	0.0000
Doornik-Hansen	8		42.319	0.0000		21.813	0.0053
Currency							
Skewness	20	7.2484	218.927	0.0000	2.9830	90.096	0.0000
Kurtosis	1	42.5269	316.428	0.0000	33.9773	91.769	0.0000

		Original			Transformed		
	df	**Value**	**X^2**	**Pr > X^2**	**Value**	**X^2**	**Pr > X^2**
Henze-Zirkler	1	12.3541	558.446	0.0000	12.5276	564.253	0.0000
Doornik-Hansen	8		65.095	0.0000		18.972	0.0150
Format							
Skewness	20	2.5236	76.223	0.0000	1.0381	31.353	0.0507
Kurtosis	1	32.0070	59.103	0.0000	26.6341	6.396	0.0114
Henze-Zirkler	1	5.9229	294.835	0.0000	5.8205	289.599	0.0000
Doornik-Hansen	8		37.733	0.0000		10.806	0.2129
Accessibility							
Skewness	20	3.2100	96.952	0.0000	2.2004	66.459	0.0000
Kurtosis	1	30.7929	42.538	0.0000	28.0829	15.368	0.0001
Henze-Zirkler	1	11.5020	529.155	0.0000	11.5635	531.313	0.0000
Doornik-Hansen	8		28.861	0.0003		6.112	0.6346
Reliability							
Skewness	20	4.7905	144.691	0.0000	3.9129	118.185	0.0000
Kurtosis	1	39.3206	216.382	0.0000	37.5422	169.064	0.0000
Henze-Zirkler	1	26.8163	926.739	0.0000	26.9440	929.283	0.0000
Doornik-Hansen	8		54.355	0.0000		34.660	0.0000
Response Time							
Skewness	20	2.9813	90.047	0.0000	1.2566	37.953	0.0090
Kurtosis	1	28.2016	16.274	0.0001	24.8338	0.641	0.4234
Henze-Zirkler	1	5.5775	276.983	0.0000	5.4836	272.040	0.0000
Doornik-Hansen	8		72.427	0.0000		10.700	0.2645
Integration							
Skewness	20	3.1973	96.571	0.0000	1.1896	35.929	0.0157
Kurtosis	1	32.4718	66.165	0.0000	29.0727	23.722	0.0000
Henze-Zirkler	1	8.6571	420.511	0.0000	8.6223	419.062	0.0000

		Original			Transformed		
	df	**Value**	**X^2**	**Pr > X^2**	**Value**	**X^2**	**Pr > X^2**
Doornik-Hansen	8		26.379	0.0009		4.648	0.7945
Flexibility							
Skewness	20	1.2469	37.661	0.0097	2.6127	78.914	0.0000
Kurtosis	1	28.9085	22.211	0.0000	29.1881	24.813	0.0000
Henze-Zirkler	1	3.4017	151.223	0.0000	3.4980	157.320	0.0000
Doornik-Hansen	8		17.644	0.0241		53.521	0.0000
Information Quality							
Skewness	20	2.2328	67.438	0.0000	1.1727	35.421	0.0180
Kurtosis	1	33.1890	77.842	0.0000	29.7490	30.469	0.0000
Henze-Zirkler	1	9.1103	439.101	0.0000	9.0612	437.113	0.0000
Doornik-Hansen	8		28.148	0.0004		13.959	0.0828
System Quality							
Skewness	20	4.4688	134.974	0.0000	1.3348	40.314	0.0046
Kurtosis	1	39.8944	232.896	0.0000	34.2912	97.635	0.0000
Henze-Zirkler	1	15.8402	666.459	0.0000	15.6961	662.317	0.0000
Doornik-Hansen	8		59.424	0.0000		34.640	0.0000
Perceived Usefulness							
Skewness	56	25.1783	759.004	0.0000	16.5451	498.754	0.0000
Kurtosis	1	110.0009	1771.894	0.0000	98.2573	1164.232	0.0000
Henze-Zirkler	1	27.3818	4769.008	0.0000	25.9629	4620.369	0.0000
Doornik-Hansen	12		167.108	0.0000		144.458	0.0000
Satisfaction							
Skewness	20	2.1478	64.872	0.0000	0.9288	28.052	0.1082
Kurtosis	1	31.3654	50.010	0.0000	27.6252	12.115	0.0005
Henze-Zirkler	1	11.6871	535.629	0.0000	11.6037	532.721	0.0000

		Original			Transformed		
	df	**Value**	**X^2**	**Pr > X^2**	**Value**	**X^2**	**Pr > X^2**
Doornik-Hansen	8		25.538	0.0013		9.925	0.2703
Cost Savings							
Skewness	20	2.2168	66.957	0.0000	1.7958	54.238	0.0001
Kurtosis	1	32.8030	71.439	0.0000	30.6904	41.265	0.0000
Henze-Zirkler	1	4.9739	244.492	0.0000	5.1447	253.860	0.0000
Doornik-Hansen	8		34.443	0.0000		11.859	0.1576
Better Coooperation							
Skewness	20	3.4368	103.803	0.0000	2.6304	79.448	0.0000
Kurtosis	1	33.0178	74.967	0.0000	31.4033	50.526	0.0000
Henze-Zirkler	1	4.8185	235.845	0.0000	5.0408	248.177	0.0000
Doornik-Hansen	8		26.435	0.0009		21.402	0.0062
Reduced Uncertainty							
Skewness	20	2.9324	88.568	0.0000	2.5309	76.442	0.0000
Kurtosis	1	30.0948	34.245	0.0000	29.3172	26.063	0.0000
Henze-Zirkler	1	8.1161	397.575	0.0000	8.2977	405.366	0.0000
Doornik-Hansen	8		69.501	0.0000		6.890	0.5486

Table 61: Test statistics for skewness, kurtosis and multivariate normality.

West, Finch and Curran (1995, pp. 63-64) list “coarsely categorized variables” as a main source of non-normality. As a consequence, the χ^2 value may be inflated, parameters underestimated and error variances biased and standard errors understimated. They suggest, among other measures, to transform non-normal variables (1995, p. 71).

Following their advice, all values for the manifest variables are squared to reduce the amount of skewness. Subsequently, nine groups of items pertaining to a construct now pass the Doornik-Hansen omnibus test, where

before no group passed. Table 61 shows the test statistics for the original and the transformed data. This approach is permissable, because the assigned numbers bear no innate relation to the description of the attitude on the answer scale. The greatest effect would be that the distance between the answer points is no longer equally spaced, which might pose a problem for interpretation, but not for computation.

However, having run the estimation with the transformed data, the results differ only to a minute degree from those obtained with the original data. This applies to both parameter estimates and fit statistics. Results are reported in appendices A6 and A9. In summary, transforming the observed data to comply with a multivariate normal distribution has a negligible impact on parameter estimates and model fit. However, the path from Currency to Information Quality is now significant at the 99% level and so are the paths from Information Quality to Perceived Usefulness and from Perceived Usefulness to Better Cooperation. Notwithstanding, these increases in signifiance do not improve overal model fit as reported in appendix A10. The effect appears to be entirely due to using different numbers in the estimation method. Any change in the numbers would simply mean tinkering in order to receive favourable results, but not yield any improvement in the quality of the analysis. Therefore, the analysis will continue to violate the second assumption and proceed with the original data.

The problem of violating one or both of the assumptions is not unique to this dissertation. Babakus, Ferguson and Jöreskog (1987) investigate the "sensitivity of confirmatory maximum likelihood analysis to violations of measurement scale and distributional assumptions". They test different correlation measures and different numbers of answer categories. Their results are ambiguous as the "correlation procedure that gives the most accurate estimates of pairwise correlations as well as loading estimates also produces the poorest fit statistics" (Babakus et al., 1987, p. 227). However, they support the use of ML estimation under those circumstances, but caution to bear in mind the ramifications.

Muthén and Kaplan (1985) carry out a similar investigation in which they acknowledge that in practice, variables are used "which are highly skewed and/or kurtotic and frequently are not observed on a continuous, interval scale" (1985, p. 171). They examine the performance of different estimation methods under these conditions. This procedure is very close to the situation in this dissertation, as they use four factors loading on one latent variable and a five-point measurement scale. They find that even though "distortions of ML and GLS chi-squares and standard errors are very likely" in case of strong skewness or kurtosis, parameter estimates remain largely robust (Muthén & Kaplan, 1985, pp. 187-188).

The evidence on the suitability of the present data is twofold: The lack of effect on parameters estimates and fit statistics by transforming the manifest variables, as well as the results of the two studies discussed above. Even though they do not necessarily encourage the use of ML, neither piece of evidence absolutely discourages it. With all the benefits of the data described in section 4.1 and the lack of any prohibitative statistical objection, it is reasonable to proceed with the analysis as planned.

4.4.3 Factor Loadings

Table 62 shows the loadings of the manifest variables on their respective construct as well as their standard error. These coefficients are "interpreted just as regression coefficients in MR [multivariate regression]" (Kline, 2011, p. 160). The z-score describes the probability that the coefficent is not zero. Any absolute value greater than 1.96 leads to a rejection of the null hypothesis that the coefficient is zero at the 95% confidence level. An absolute z-score greater than 2.56 rejects the null hypothesis at the 99% confidence level. (Kline, 2011, p. 34) The table also shows the corresponding p-value for rejecting the null hypothesis as well as the 95% confidence interval in which the coefficients lie. The coefficient of the first item pertaining to each construct is constrained to a value of "1" to set the numeric scale for the estimates.

From	To	Coef.	Std. Err.	z	P>|z|	95% Conf. Int.	
Accuracy	**Acc1**	1.0000	(const.)				
	Acc2	1.0756	0.0969	11.10	0.000	0.8856	1.2656
	Acc3	0.8999	0.0792	11.36	0.000	0.7446	1.0552
	Acc4	1.0059	0.1037	9.70	0.000	0.8027	1.2091
Completeness	**Comp1**	1.0000	(const.)				
	Comp2	0.7557	0.0860	8.78	0.000	0.5870	0.9243
	Comp3	0.8902	0.0872	10.21	0.000	0.7194	1.0611
	Comp4	0.8995	0.0960	9.37	0.000	0.7115	1.0876
Currency	**Curr1**	1.0000	(const.)				
	Curr2	0.9756	0.0960	10.17	0.000	0.7875	1.1637
	Curr3	0.9306	0.1073	8.68	0.000	0.7204	1.1409
	Curr4	1.0894	0.1061	10.27	0.000	0.8815	1.2973
Format	**Form1**	1.0000	(const.)				
	Form2	1.0651	0.0797	13.36	0.000	0.9089	1.2214
	Form3	0.9181	0.0781	11.76	0.000	0.7651	1.0711
	Form4	0.5741	0.1064	5.40	0.000	0.3655	0.7827
Accessibility	**Access1**	1.0000	(const.)				
	Access2	1.1248	0.1167	9.64	0.000	0.8962	1.3535
	Access3	1.3521	0.1322	10.23	0.000	1.0929	1.6113
	Access4	1.3907	0.1347	10.32	0.000	1.1267	1.6547
Reliability	**Rel1**	1.0000	(const.)				
	Rel2	0.9839	0.0637	15.44	0.000	0.8590	1.1088
	Rel3	1.0742	0.0678	15.84	0.000	0.9413	1.2072
	Rel4	0.9482	0.0648	14.63	0.000	0.8212	1.0752
Response Time	**Resp1**	1.0000	(const.)				
	Resp2	0.8253	0.1235	6.68	0.000	0.5833	1.0673
	Resp3	1.2421	0.1627	7.64	0.000	0.9233	1.5609

From	To	Coef.	Std. Err.	z	P>|z|	95% Conf. Int.	
	Resp4	1.0641	0.1455	7.31	0.000	0.7789	1.3492
Flexibility	**Flex1**	1.0000	(const.)				
	Flex2	1.2214	0.1047	11.67	0.000	1.0163	1.4265
	Flex3	-1.2092	0.1049	-11.52	0.000	-1.4148	-1.0036
	Flex4	-0.4304	0.1210	-3.56	0.000	-0.6676	-0.1932
Integration	**Int1**	1.0000	(const.)				
	Int2	0.7948	0.0644	12.34	0.000	0.6686	0.9211
	Int3	1.0266	0.0581	17.68	0.000	0.9128	1.1404
	Int4	0.7666	0.0698	10.98	0.000	0.6298	0.9034
Information Quality	**Info1**	1.0000	(const.)				
	Info2	1.0511	0.0706	14.88	0.000	0.9126	1.1896
	Info3	1.0230	0.0761	13.45	0.000	0.8739	1.1722
	Info4	0.9736	0.1021	9.54	0.000	0.7736	1.1737
System Quality	**Sys1**	1.0000	(const.)				
	Sys2	1.1561	0.0698	16.56	0.000	1.0192	1.2929
	Sys3	1.0459	0.0664	15.76	0.000	0.9158	1.1760
	Sys4	0.9723	0.0755	12.88	0.000	0.8243	1.1203
Perceived Usefulness	**Use1**	1.0000	(const.)				
	Use2	0.9787	0.0675	14.50	0.000	0.8464	1.1110
	Use3	1.0625	0.0620	17.13	0.000	0.9409	1.1840
	Use4	1.0704	0.0633	16.91	0.000	0.9464	1.1944
	Use5	0.9983	0.0648	15.40	0.000	0.8712	1.1254
	Use6	0.9362	0.0584	16.40	0.000	0.8219	1.0506
Satisfaction	**Satis1**	1.0000	(const.)				
	Satis2	1.0632	0.0778	13.67	0.000	0.9108	1.2156
	Satis3	1.0501	0.0766	13.71	0.000	0.9001	1.2002

From	To	Coef.	Std. Err.	z	P>|z|	95% Conf. Int.	
	Satis4	1.0502	0.0793	13.24	0.000	0.8947	1.2057
Cost Savings	**Cost1**	1.0000	(const.)				
	Cost2	1.1963	0.1262	9.48	0.000	0.9489	1.4437
	Cost3	0.9406	0.1200	7.84	0.000	0.7054	1.1758
	Cost4	1.0565	0.1215	8.69	0.000	0.8183	1.2947
Better Cooperation	**Coop1**	1.0000	(const.)				
	Coop2	1.1274	0.1001	11.26	0.000	0.9311	1.3236
	Coop3	0.7241	0.1157	6.26	0.000	0.4973	0.9509
	Coop4	1.0666	0.0932	11.44	0.000	0.8839	1.2493
Reduced Uncertainty	**Unc1**	1.0000	(const.)				
	Unc3	1.1502	0.1573	7.31	0.000	0.8420	1.4585
	Unc3	1.0941	0.1593	6.87	0.000	0.7820	1.4062
	Unc4	1.0897	0.1757	6.20	0.000	0.7453	1.4340

Table 62: Factor loadings.

All coefficents are statistically significant and the magnitude of the loading is comparatively equal for most items. However, there are a few excpetions. Items Flex3 and Flex4 have negative coefficients which means that a high score in these variables is reflected in a lower score in the construct. Furthermore, the three items Form4, Resp1 and Flex3, which had to be reverse coded, show fairly low loadings. Resp1, of course, does not count in this respect because it is constrained to “1”.

4.4.4 Coefficients

Table 63 shows the path coefficients among constructs. They are interpreted in the same way as the factor loadings of the manifest variables. Covariance between the constructs was constrained to “0”.

From	To	Coef.	Std. Err.	z	P>|z|	95% Conf.	Interval
Accuracy	**Information Quality**	0.5716	0.0761	7.51	0.000	0.4224	0.7207
Completeness		0.2012	0.0532	3.78	0.000	0.0969	0.3055
Currency		0.1142	0.0623	1.83	0.067	-0.0080	0.2363
Format		0.2163	0.0489	4.43	0.000	0.1205	0.3120
Information Quality	**Perceived Usefulness**	0.1913	0.1069	1.79	0.073	-0.0181	0.4007
System Quality		0.5811	0.1073	5.41	0.000	0.3707	0.7915
Information Quality	**Satisfaction**	0.2069	0.0555	3.73	0.000	0.0981	0.3157
Perceived Usefulness		0.3625	0.0521	6.96	0.000	0.2605	0.4645
System Quality		0.4805	0.0678	7.80	0.000	0.3475	0.6134
Accessibility	**System Quality**	0.2707	0.0927	2.92	0.003	0.0891	0.4524
Reliability		0.5093	0.0830	6.14	0.000	0.3468	0.6719
Response Time		-0.0104	0.0791	-0.13	0.895	-0.1655	0.1446
Flexibility		0.2463	0.0622	3.96	0.000	0.1243	0.3683
Integration		0.1804	0.0470	3.84	0.000	0.0883	0.2724
Perceived Usefulness	**Cost Savings**	-0.1757	0.1378	-1.27	0.202	-0.4458	0.0945
Satisfaction		0.7439	0.1632	4.56	0.000	0.4240	1.0638
Perceived Usefulness	**Better Cooperation**	-0.2786	0.1500	-1.86	0.063	-0.5725	0.0153
Satisfaction		0.8142	0.1730	4.71	0.000	0.4751	1.1533
Perceived Usefulness	**Reduced Uncertainty**	0.0724	0.0886	0.82	0.413	-0.1012	0.2460
Satisfaction		0.5075	0.1149	4.42	0.000	0.2823	0.7326

Table 63: Coefficients.

All coefficients are statistically significant with the following exceptions:

- Currency to Information Quality
- Response Time to System Quality

- Information Quality to Perceived Usefulness
- Perceived Usefulness to all of Cost Savings, Better Cooperation and Reduced Uncertainty

The path between Response Time and System Quality is both statistically insignificant and close to zero. Therefore, a change in Response Time does not lead to a change in System Quality. All paths from Perceived Usefulness to Cost Savings, Better Cooperation and Reduced Uncertainty are statistically not significant and either negative or close to zero. Hence, a change in Perceived Usefulness does not lead to a significant change in Net Benefits for managerial accounting.

4.4.5 Variances

Table 64 shows the error variance associated with the manifest variables and the endogenous latent variables as well as the variance of the exogenous latent variables.

	Coef.	Std. Err.	95% Conf. Interval	
Errors related to items				
Acc1	0.1855	0.0287	0.1370	0.2511
Acc2	0.3252	0.0435	0.2502	0.4228
Acc3	0.1776	0.0253	0.1344	0.2347
Acc4	0.3619	0.0464	0.2814	0.4654
Comp1	0.2585	0.0492	0.1780	0.3754
Comp2	0.3858	0.0503	0.2988	0.4981
Comp3	0.3536	0.0504	0.2675	0.4675
Comp4	0.5328	0.0681	0.4147	0.6845
Curr1	0.2674	0.0379	0.2026	0.3530
Curr2	0.2242	0.0351	0.1650	0.3045
Curr3	0.2780	0.0373	0.2136	0.3617

	Coef.	Std. Err.	95% Conf. Interval	
Curr4	0.1760	0.0341	0.1204	0.2573
Form1	0.2108	0.0355	0.1516	0.2932
Form2	0.1398	0.0334	0.0876	0.2232
Form3	0.2941	0.0384	0.2277	0.3798
Form4	0.8920	0.0971	0.7206	1.1042
Access1	0.3022	0.0368	0.2380	0.3837
Access2	0.2330	0.0313	0.1791	0.3033
Access3	0.1511	0.0275	0.1059	0.2158
Access4	0.1993	0.0321	0.1454	0.2734
Rel1	0.0887	0.0139	0.0652	0.1205
Rel2	0.1179	0.0164	0.0898	0.1547
Rel3	0.1338	0.0188	0.1015	0.1763
Rel4	0.1313	0.0175	0.1011	0.1705
Resp1	0.6944	0.0788	0.5559	0.8674
Resp2	0.2866	0.0342	0.2268	0.3622
Resp3	0.0812	0.0358	0.0343	0.1925
Resp4	0.2871	0.0419	0.2156	0.3821
Flex1	0.3425	0.0435	0.2671	0.4392
Flex2	0.1846	0.0388	0.1223	0.2785
Flex3	0.1932	0.0388	0.1303	0.2863
Flex4	0.9690	0.1042	0.7849	1.1963
Int1	0.1398	0.0271	0.0955	0.2045
Int2	0.3362	0.0398	0.2666	0.4241
Int3	0.1249	0.0272	0.0816	0.1914
Int4	0.4159	0.0479	0.3319	0.5212

	Coef.	Std. Err.	95% Conf. Interval	
Info1	0.1301	0.0191	0.0975	0.1736
Info2	0.1662	0.0233	0.1263	0.2189
Info3	0.2109	0.0272	0.1638	0.2716
Info4	0.5000	0.0580	0.3983	0.6277
Sys1	0.1606	0.0204	0.1252	0.2061
Sys2	0.1297	0.0195	0.0966	0.1741
Sys3	0.1370	0.0187	0.1048	0.1790
Sys4	0.2538	0.0303	0.2008	0.3208
Use1	0.1967	0.0232	0.1561	0.2479
Use2	0.1831	0.0216	0.1453	0.2307
Use3	0.0844	0.0121	0.0637	0.1116
Use4	0.0939	0.0130	0.0716	0.1230
Use5	0.1448	0.0177	0.1140	0.1839
Use6	0.1041	0.0132	0.0812	0.1335
Satis1	0.2051	0.0242	0.1627	0.2585
Satis2	0.1807	0.0218	0.1426	0.2290
Satis3	0.1806	0.0220	0.1422	0.2294
Satis4	0.2069	0.0249	0.1634	0.2620
Cost1	0.3139	0.0440	0.2385	0.4130
Cost2	0.2883	0.0484	0.2074	0.4008
Cost3	0.4645	0.0573	0.3647	0.5916
Cost4	0.4116	0.0545	0.3175	0.5336
Coop1	0.2248	0.0350	0.1656	0.3051
Coop2	0.2856	0.0450	0.2096	0.3890
Coop3	0.7534	0.0846	0.6046	0.9387

	Coef.	Std. Err.	95% Conf. Interval	
Coop4	0.2464	0.0391	0.1805	0.3362
Unc1	0.3796	0.0458	0.2997	0.4808
Unc2	0.1627	0.0265	0.1183	0.2239
Unc3	0.3367	0.0425	0.2630	0.4312
Unc4	0.4453	0.0532	0.3523	0.5628
Errors related to endogenous latent variables				
Information Quality	0.0701	0.0174	0.0431	0.1140
Perceived Usefulness	0.2512	0.0381	0.1867	0.3381
Satisfaction	0.0234	0.0082	0.0118	0.0465
System Quality	0.1047	0.0187	0.0738	0.1486
Cost Savings	0.2382	0.0474	0.1612	0.3519
Better Cooperation	0.3095	0.0526	0.2219	0.4318
Reduced Uncertainty	0.0740	0.0218	0.0415	0.1319
Variances of exogenous latent variables				
Accuracy	0.3845	0.0610	0.2818	0.5246
Completeness	0.6053	0.0967	0.4426	0.8278
Currency	0.3623	0.0656	0.2541	0.5166
Format	0.5357	0.0809	0.3984	0.7203
Accessibility	0.2903	0.0571	0.1974	0.4268
Reliability	0.3335	0.0450	0.2559	0.4346
Response Time	0.3255	0.0841	0.1962	0.5400
Flexibility	0.4503	0.0796	0.3184	0.6368
Integration	0.6568	0.0864	0.5075	0.8500

Table 64: Error variances of items and endogenous latent variables and variances of exogenous latent variables.

As expected, no variable is fully described by either observational data or the hypothesised relationship to another variable. Comparatively large error variances are found for the items Form4 and Resp1, both of which had to be reverse coded, and for items Flex4 and Coop3.

In addition to an error variance, all dependend variables exhibit variances as well. Table 65 reports the fitted variance, the variance predicted by the model and the residual variance. It also shows the R^2 for each dependent variable, i.e. the amount of variance that is explained by the structural equation model. The columns mc and mc^2 report the multiple correlation and the squared multiple correlation, respectively. All three tests (R^2, mc and mc^2) measure "the predictability of a dependent variable" (Bentler & Raykov, 2000, p. 125). The values are the same in case of recursive models, but in the present case of a non-recursive model, they are distinct (Hamilton & Stata, 2011, p. 71).

	Variance					
	fitted	**predicted**	**residual**	**R^2**	**mc**	**mc^2**
Items						
Acc1	0.5700	0.3845	0.1855	0.67	0.8213	0.6745
Acc2	0.7701	0.4448	0.3252	0.58	0.7600	0.5776
Acc3	0.4890	0.3114	0.1776	0.64	0.7980	0.6368
Acc4	0.7509	0.3890	0.3619	0.52	0.7198	0.5181
Comp1	0.8638	0.6053	0.2585	0.70	0.8371	0.7007
Comp2	0.7315	0.3457	0.3858	0.47	0.6874	0.4726
Comp3	0.8333	0.4797	0.3536	0.58	0.7587	0.5756
Comp4	1.0226	0.4898	0.5328	0.48	0.6921	0.4790
Curr1	0.6298	0.3623	0.2674	0.58	0.7585	0.5754
Curr2	0.5691	0.3449	0.2242	0.61	0.7785	0.6061
Curr3	0.5918	0.3138	0.2780	0.53	0.7282	0.5303
Curr4	0.6060	0.4300	0.1760	0.71	0.8424	0.7096
Form1	0.7465	0.5357	0.2108	0.72	0.8471	0.7176

	Variance					
	fitted	**predicted**	**residual**	**R^2**	**mc**	**mc^2**
Form2	0.7476	0.6078	0.1398	0.81	0.9017	0.8130
Form3	0.7456	0.4516	0.2941	0.61	0.7782	0.6056
Form4	1.0685	0.1766	0.8920	0.17	0.4065	0.1652
Access1	0.5924	0.2903	0.3022	0.49	0.7000	0.4899
Access2	0.6003	0.3672	0.2330	0.61	0.7822	0.6118
Access3	0.6818	0.5307	0.1511	0.78	0.8822	0.7783
Access4	0.7607	0.5614	0.1993	0.74	0.8590	0.7379
Rel1	0.4222	0.3335	0.0887	0.79	0.8888	0.7900
Rel2	0.4407	0.3228	0.1179	0.73	0.8559	0.7326
Rel3	0.5186	0.3848	0.1338	0.74	0.8614	0.7420
Rel4	0.4312	0.2999	0.1313	0.70	0.8339	0.6955
Resp1	1.0199	0.3255	0.6944	0.32	0.5650	0.3192
Resp2	0.5083	0.2217	0.2866	0.44	0.6604	0.4362
Resp3	0.5834	0.5022	0.0812	0.86	0.9278	0.8608
Resp4	0.6556	0.3686	0.2871	0.56	0.7498	0.5622
Flex1	0.7927	0.4503	0.3425	0.57	0.7536	0.5680
Flex2	0.8563	0.6717	0.1846	0.78	0.8857	0.7845
Flex3	0.8515	0.6584	0.1932	0.77	0.8793	0.7731
Flex4	1.0524	0.0834	0.9690	0.08	0.2815	0.0792
Int1	0.7966	0.6568	0.1398	0.82	0.9080	0.8245
Int2	0.7512	0.4150	0.3362	0.55	0.7432	0.5524
Int3	0.8172	0.6923	0.1249	0.85	0.9204	0.8471
Int4	0.8019	0.3860	0.4159	0.48	0.6938	0.4813
Info1	0.3801	0.2500	0.1301	0.66	0.8110	0.6577
Info2	0.4424	0.2762	0.1662	0.62	0.7901	0.6243
Info3	0.4726	0.2616	0.2109	0.55	0.7441	0.5536

	Variance					
	fitted	**predicted**	**residual**	**R^2**	**mc**	**mc^2**
Info4	0.7370	0.2370	0.5000	0.32	0.5671	0.3216
Sys1	0.4219	0.2612	0.1606	0.62	0.7869	0.6192
Sys2	0.4788	0.3491	0.1297	0.73	0.8539	0.7292
Sys3	0.4227	0.2857	0.1370	0.68	0.8222	0.6760
Sys4	0.5008	0.2470	0.2538	0.49	0.7023	0.4932
Use1	0.5453	0.3486	0.1967	0.64	0.7995	0.6393
Use2	0.5170	0.3339	0.1831	0.65	0.8037	0.6459
Use3	0.4779	0.3935	0.0844	0.82	0.9075	0.8235
Use4	0.4933	0.3994	0.0939	0.81	0.8999	0.8097
Use5	0.4922	0.3474	0.1448	0.71	0.8401	0.7058
Use6	0.4097	0.3056	0.1041	0.75	0.8636	0.7459
Satis1	0.4054	0.2003	0.2051	0.49	0.7029	0.4941
Satis2	0.4071	0.2264	0.1807	0.56	0.7457	0.5561
Satis3	0.4015	0.2209	0.1806	0.55	0.7417	0.5501
Satis4	0.4278	0.2209	0.2069	0.52	0.7186	0.5163
Cost1	0.6190	0.3051	0.3139	0.49	0.7021	0.4929
Cost2	0.7249	0.4366	0.2883	0.60	0.7761	0.6023
Cost3	0.7345	0.2699	0.4645	0.37	0.6062	0.3675
Cost4	0.7521	0.3405	0.4116	0.45	0.6729	0.4527
Coop1	0.5992	0.3744	0.2248	0.62	0.7905	0.6249
Coop2	0.7614	0.4759	0.2856	0.62	0.7906	0.6250
Coop3	0.9497	0.1963	0.7534	0.21	0.4547	0.2067
Coop4	0.6723	0.4260	0.2464	0.63	0.7960	0.6336
Unc1	0.5224	0.1428	0.3796	0.27	0.5228	0.2733
Unc2	0.3516	0.1889	0.1627	0.54	0.7329	0.5372
Unc3	0.5076	0.1709	0.3367	0.34	0.5802	0.3366

	Variance					
	fitted	**predicted**	**residual**	**R^2**	**mc**	**mc^2**
Unc4	0.6148	0.1695	0.4453	0.28	0.5251	0.2757
Endogenous latent variables						
Information Quality	0.2500	0.1799	0.0701	0.72	0.8483	0.7195
Satisfaction	0.2003	0.1769	0.0234	0.88	0.9397	0.8831
Perceived Usefulness	0.3486	0.0973	0.2512	0.28	0.5284	0.2793
System Quality	0.2612	0.1565	0.1047	0.60	0.7740	0.5991
Cost Savings	0.3051	0.0669	0.2382	0.22	0.4683	0.2193
Better Cooperation	0.3744	0.0649	0.3095	0.17	0.4164	0.1734
Reduced Uncertainty	0.1428	0.0688	0.0740	0.48	0.6941	0.4818

Table 65: Variance and predictability of dependent variables.

Of all the dependent variables, the values for the endogenous latent variables are especially interesting because the purpose of the model is to explain their variance. Observed variables are also dependent due to the reflective relationship to their respective construct, but the interpretation of their predictability is less relevant.

Information Quality, System Quality and Satisfaction show fairly high values for R^2 and mc^2, which means that a large amount of their variance is explained by the model. The R^2 and mc^2 are comparatively low for Perceived Usefulness, Cost Savings, Better Cooperation and Reduced Uncertainty. Thus, the model can only explain a small part of their variance.

4.4.6 Complete Model

Figure 43 shows the research model and the parameter estimates. Error variances are omitted from the graph to ensure readability. Constrained parameters are indicated by a superscript “c”.

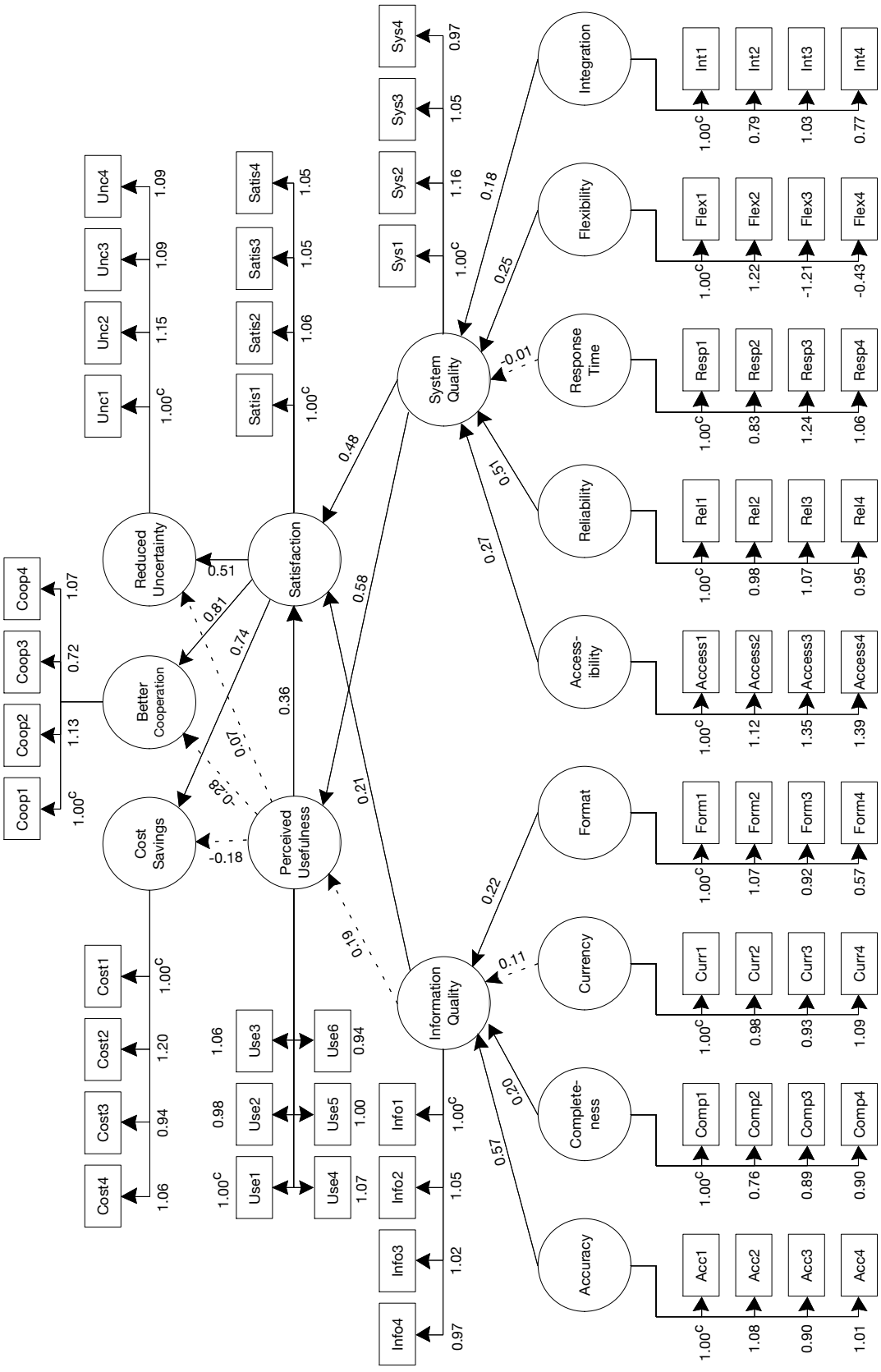


Figure 43: Complete model with factor loadings, path coefficients and significance levels.
Dotted line paths are not significant at the 95% confidence level.

4.5 Model Fit

Stata provides several tests for how well the model fits the data. Table 66 lists these tests and their respective values.

	Value	Description
Likelihood ratio		
χ^2	3,923.542	model vs. saturated
Degrees of Freedom	2059	
$p > \chi^2$	0.000	
Population error		
RMSEA	0.072	Root mean squared error of approximation
90% CI, lower bound	0.000	
upper bound	NA	
pclose	NA	Probability RMSEA ≤ 0.05
Baseline comparison		
CFI	0.793	Comparative fit index
TLI	0.785	Tucker-Lewis index
Size of residuals		
SRMR	0.284	Standardised root mean squared residual
CD	1.000	Coefficient of determination

Table 66: Fit statistics.

The likelihood ratio measures how well the model fits the data compared to the saturated model, which fits the model perfecty. This test rejects the null hypothesis that the research model fits the data equally well as the saturated model.

Gefen et al. suggest that the χ^2 statistic be as low as possible and that the ratio of χ^2 to the degrees of freedom should not exceed 3:1 (Gefen et al.,

2000, p. 35). In the present instance, the ratio is 1.91 and thus well within this boundary.

The test for population error would not reject the null hypothesis of close fit if the lower bound is below 0.05. This is given in the present instance.

The two baseline comparison fit indices denote good fit if they are close to 1. Those values reported above are certainly close to 1, but could indeed be even closer.

The tests for the size of residuals show different results. The SRMR value is too large to indicate a good fit, whereas the coefficient of determination (which can range from 0 to 1) indicates good fit.

Apparently, results for model fit are mixed. Some tests show good fit, whereas others do not. Kline lists a number of general problems with fit statistics (2011, pp. 192-193) which address this ambivalence:

1. “Values of fit statistics indicate only the average or overall fit of a model. That is, fit statistics collapse many discrepancies into a single measure […]
2. Because a single statistic reflects only a particular aspect of fit, a favorable value of that statistic does not by itself indicate acceptable fit.
3. Unfortunately, there is little direct relation between values of fit statistics and the degree or type of misspecification […]
4. Values of fit statistics that suggest adequate fit do not also indicate that the predictive power of the model is also high as measured by statistics for individual endogenous variables […]
5. Fit statistics do not indicate whether the results are theoretically meaningful.”

All of these points apply to the anaylsis in this dissertation. The last point, however, is particularily important, especially when taken vice versa: What happens when a theoretically meaningful model yields poor fit statistics?

Typically, the cause of poor fit is a misspecified model. Some paths in the specified model may have indeed proven not to be meaningful empirically, even though they appear to be so theoretically. This is a major result of the analysis and poor fit is an indication of that. There is also a difference between confirmatory and exploratory resarch. The first tests the relationships between a given set of variables, whereas the latter seeks to deduce variables from the data and to achieve good fit by either adding or removing variables and paths. Jöreskog (1969, p. 185) acknowledges this difference and comments on the use of goodness-of-fit statistics as follows: "When to stop fitting additional parameters cannot be decided on a purely statistical basis. This is largely a matter of the experimenter's interpretations of the data based on substantive theoretical and conceptual considerations. Ultimately the criteria for goodness of the model depend on the usefulness of it and the results it produces." (Jöreskog, 1969, p. 201)

4.6 Evaluating the Hypotheses

4.6.1 Confirmed Hypotheses

Table 67 lists all the hypotheses that are confirmed by the analysis alongside their respective coefficients. A total of 16 out of 20 hypotheses are confirmed. All these hypotheses are confirmed at the 99% confidence level.

H	Latent Variable	Predictor	Coefficient	Confidence Level
1	Information Quality	Accuracy	0.57	99%
2	Information Quality	Completeness	0.20	99%
4	Information Quality	Format	0.22	99%
5	System Quality	Accessibility	0.27	99%
6	System Quality	Reliability	0.51	99%

H	Latent Variable	Predictor	Coefficient	Confidence Level
8	System Quality	Flexibility	0.35	99%
9	System Quality	Integration	0.18	99%
11	Satisfaction	Information Quality	0.21	99%
12	Perceived Usefulness	System Quality	0.48	99%
13	Satisfaction	System Quality	0.48	99%
14	Satisfaction	Perceived Usefulness	0.36	99%
16	Cost Savings	Satisfaction	0.74	99%
18	Better Cooperation	Satisfaction	0.81	99%
20	Reduced Uncertainty	Satisfaction	0.51	99%

Table 67: Confirmed hypotheses and confidence levels.

4.6.2 Rejected Hypotheses

Table 68 lists all the hypotheses that are rejected by the analysis alongside their respective coefficients. A total of 4 out of 20 hypotheses are rejected. They are rejected either because their relationship is negative as opposed to the assumed positive relationship, or because the coeffients are not statistically significant above the 95% confidence level.

H	Latent Variable	Predictor	Coefficient	Confidence Level
3	Information Quality	Currency	0.11	< 95%
7	System Quality	Response Time	-0.01	< 95%
10	Perceived Usefulness	Information Quality	0.19	< 95%

H	Latent Variable	Predictor	Coefficient	Confidence Level
15	Cost Savings	Perceived Usefulness	-0.18	< 95%
17	Better Cooperation	Perceived Usefulness	-0.28	< 95%
19	Reduced Uncertainty	Perceived Usefulness	0.07	< 95%

Table 68: Rejected hypotheses and confidence levels.

5 Discussion

This chapter starts with discussing the results of empirically testing the hypotheses as well as the implications for the research model. The discussion also includes the consistently negative attitudes which are observed in the survey as well as the implications for IS success research.

5.1 Evaluation of the Research Model

5.1.1 Antecedents

A first step in evaluating the research model is to look at the antecedents. The four antecedents pertaining to Information Quality and the five antecedents pertaining to System Quality have been adapted from Nelson, Todd & Wixom (2005). Table 69 compares the path coefficients found in this study to those found by Nelson et al. for their three samples of a “predefined reporting software”, “query tools” and “analysis tools”.

It is remarkable how closely the findings of both studies match. Accuracy has the strongest impact on Information Quality, followed by Completeness and Format. Currency has the smallest impact and its relation is not significant at the 95% level in either study. With regard to System Quality, Reliability has the strongest impact. Accessibillity and Flexibility rank second or third, depending on the study and sample. They have an approximately equal impact on System Quality. Integration ranks as the lowest significant impact. The impact of Response Time is miniscule, even slightly negative in the findings of this study. It is not significant at the 95% level except for the “analysis tools” sample.

		Nelson, Todd & Wixom		
		Predefined reporting software	**Query tools**	**Analysis tools**
Information Quality				
Accuracy	0.572	0.501	0.442	0.376
Completeness	0.201	0.290	0.318	0.363
Currency	0.114✖	0.013✖	0.051✖	0.056✖
Format	0.216	0.257	0.236	0.220
System Quality				
Accessibility	0.271	0.358	0.209	0.236
Reliability	0.509	0.382	0.361	0.387
Response Time	-0.010✖	0.037✖	0.078✖	0.108
Flexibility	0.246	0.141	0.283	0.167
Integration	0.180	0.100	0.089	0.118

Table 69: Path coefficients of antecedents compared to findings by Nelson et al. All values are significant at the 99% level, except for those marked "✖". Adapted from Nelson, Todd & Wixom (2005).

In the Nelson et al. study, the four antecedents of Information Quality explained more than 75% of its variance. This study finds an R^2 of 0.72 and an mc^2 of also 0.72. For System Quality, Nelson et al. report an explained variance of approximately 75%, compared to an R^2 of 0.60 and an mc^2 of also 0.60 in this study. (Nelson et al., 2005, pp. 214-215) These results show slightly better explanatory power of the antecedents in Nelson et al.'s study, but that may be due to their specific context of data warehouse systems. Overall, results are very comparable and consistent across the two studies.

Besides contributing to Nelson et al.'s request "to test the consistency and robustness of this finding across other contexts" (2005, p. 217), this study shows how important accuracte, complete and well-formatted information is

as a contributor to information quality. Nelson at al. explain the lack of statistical signifiance for Currency by the nature of the items which ask for absolute currency (e.g. “always up-to-date”), which might not necessarily apply to a data warehouse system (2005, p. 218). Managerial accounting, on the other hand, does rely on current information and any delay in obtaining the latest information might lead to suboptimal decision-making. However, manufacturing is an industry that might be comparativley low-paced and a piece of information might retain its relevance for a long time.

Realiability turns out to be the strongest contributor to System Quality. This result is not surprising, nor is the approximately equal influence of Accessibility and Flexibility. They constitute key system characteristics without which an IS could hardly be viable. Integration plays a lesser, but still significant part. The influence of Response Time is as close as makes no difference to zero. It’s lack of statistical significance is also found in two out of three samples in the Nelson et a. study. They use the same rationale as with Currency to explain this result (2005, pp. 218-219). Across Information Quality and System Quality, the two items, which explicitly reflect the concept of time, are not significant.

Despite the potential reasons offered by Nelson et al. and those just discussed, it ultimately remains unclear why these two items do not have a significant influence. Apparently, conducting manageral accounting at SMEs using an IS does not depend on time-critial operations. Nevertheless, hypotheses 3 and 7 have to be rejected, whereas hypotheses 1, 2, 4, 5, 6, 8 and 9 cannot be rejected based on the results obtained in this study.

5.1.2 DeLone & McLean Variables

The relationships between the other constructs show mixed results. Because the research model deviates from DeLone and McLean’s 10-year update (2003) by replacing Use and Intention to Use with Perceived Usefulness, comparison to other studies based on the original model are limited. Nevertheless, Seddon and Kiew (1992), who first suggested the construct

Perceived Usefulness and its unidirectional influence on Satisfaction, also conducted a path analysis of their model and reported their findings.

In 2009, Petter and McLean published a meta-analysis of 52 studies which empirically test the DeLone and McLean model. Their analysis of hypothesised relationships between variables is based on the updated model, so only the findings for the impact of Information Quality and System Quality on Satisfaction are applicable to this study. They find strong support at the 95% level for these two paths. The result of their meta-analysis reveals an effect size of 0.53 for the impact of Information Quality on Satisfaction and an effect size of 0.54 for the impact of System Quality on Satisfaction. (Petter & McLean, 2009, pp. 162-164) While the effect size denotes correlation between two variables across many studies, the path coefficients found in this study are 0.21 and 0.48, respectively. Thus, the influence of Information Quality on Satisfaction is weaker than suggested by Petter and McLean, but the influence of System Quality is comparable.

Table 70 shows the path coefficients and signifiance levels reported by Seddon and Kiew (1994) as well as those found in this study. Values for the relationship between Perceived Usefulness and Satisfaction correspond closely, whereas the impact of System Quality on Perceived Usefulness and Satisfaction appears to be slightly greater in this study than in Seddon and Kiew's. By contrast, they find a stronger influence of Information Quality on Satisfaction. The impact of Information Quality on Perceived Usefulness is the weakest in both studies, albeit the relationship is still significant at the 95% level in Seddon and Kiews's results. As their result for that path was still significant, Seddon and Kiew had no reason to comment on it except for their observation that "Information Quality […] also made some contribution to user perceptions of Usefulness" (Seddon & Kiew, 1994, p. 105). They report values for R^2 based on regression analysis, with swapping Perceived Usefulness (0.56) and Satisfaction (0.73) as the dependent variable. (Seddon & Kiew, 1994, p. 107) Unfortunately, these values cannot be directly compared to the R^2 found in this study. Perceived Usefulness has an R^2 and

mc^2 of 0.28, which is low and suggests that there are other unfluencing factors besides effectively just System Quality. The R^2 and mc^2 for Satisfaction is 0.88, which suggests that its variance is reasonably well explained by Information Quality, System Quality and Perceived Usefulness.

From	To		Seddon & Kiew
Information Quality	**Perceived Usefulness**	0.191✖	0.174■
Information Quality	**Satisfaction**	0.207	0.415
System Quality	**Perceived Usefulness**	0.581	0.350
System Quality	**Satisfaction**	0.480	0.260
Perceived Usefulness	**Satisfaction**	0.362	0.349

Table 70: Path coefficients compared to findings by Seddon and Kiew.
All values are significant at the 99% level, except for those marked "■" (95% level) and "✖" (below 95% level). Adapted from Seddon & Kiew, 1994, p. 106.

The lack of significance for the relationship between Information Quality and Perceived Usefulness may well be an anomaly of this study. There is little reason to assume that an increase in the quality of information provided by the IS would not have a positive, significant influence on users' perceptions of the usefulness of the IS. Furthermore, as demonstrated in the previous chapter, the path could become significant if it were calculated with truly multivariate normal data. This study, however, leads to a rejection of hypothesis 10. On the other hand, hypotheses 11, 12, 13 and 14 cannot be rejected.

5.1.3 Net Benefits

Results for Cost Savings, Better Cooperation and Reduced Uncertainty reveal Satisfaction as the only positive and significant influence. The coefficients for the paths from Perceived Usefulness to Cost Savings and Better Cooperation are negative and close to zero for the path to Reduced

Uncertainty. All paths are not statistically significant above the 95% level. However, path coefficients are 0.74, 0.81 and 0.51 for Satisfaction, respectively. They are all significant at the 99% level. Because there appears to be only one meaningful predictor, the R^2 and mc^2 are 0.22 for Cost Savings, 0.17 for Better Cooperation and 0.48 for Reduced Uncertainty. As a consequence, a large amount of the variance in these constructs remains unexplained by Satisfaction.

As the path from Perceived Usefulness to Satisfaction is statistically significant, the effect of Perceived Usefulness on the Net Benefits may be mediated by Satisfaction. In order to test this hypothesis, parameters in the research model are estimated again, this time without Satisfaction, its items and all paths leading to and from that construct. Now Perseived Usefulness has an impact on Cost Savings, Better Cooperation and Reduced Uncertainty, each at the 99% confidence level. However, the R^2 decreases for all the Net Benefits. Table 71 contrasts the parameters before and after excluding Satisfaction.

	Including Satisfaction	**Excluding Satisfaction**
From Perceived Usefulness to Cost Savings		
Coefficient	-0.1757	0.4371
Standard Error	0.1378	0.0776
z	-1.27	5.63
p>|z|	0.202	0.000
95% Conf. Interval	[-0.4458 – 0.0945]	[0.2850 – 0.5891]
From Perceived Usefulness to Better Cooperation		
Coefficient	-0.2786	0.3845
Standard Error	0.1500	0.0798
z	-1.86	4.82
p>|z|	0.063	0.000
95% Conf. Interval	[-05725 – 0.0153]	[0.2280 – 0.5409]

	Including Satisfaction	Excluding Satisfaction
From Perceived Usefulness to Reduced Uncertainty		
Coefficient	0.0724	0.4835
Standard Error	0.0886	0.0716
z	0.82	6.75
p>|z|	0.413	0.000
95% Conf. Interval	[-0.1012 – 0.2460]	[0.3431 – 0.6239]
Cost Savings		
R^2	0.22	0.19
mc	0.4683	0.4309
mc^2	0.2193	0.1857
Better Cooperation		
R^2	0.17	0.12
mc	0.4164	0.3449
mc^2	0.4818	0.1190
Reduced Uncertainty		
R^2	0.48	0.46
mc	0.6941	0.6796
mc^2	0.4818	0.4619

Table 71: Parameters including and excluding Satisfaction.

These findings suggest several things:

1. Irrespective of how useful users perceive their IS to be, any positive effect on conducting managerial accounting is only achieved when they are satisfied with the system. A system that is technically adquate, but fails to satify users will not have such a positive effect.

2. System Quality (and possibly Information Quality) have an effect on Net Benefits only through Satisfaction.

3. The effect of Perceived Usefulness on Net Benefits is mediated by Satisfaction.

4. The research model explains the benefits of managerial accounting only to a small degree. Maybe the benefits are unrelated to using an IS or there are other unkown unfluencing factors.

The crucial role of user satisfaction for achieving managerial accounting benefits is congruent with the original notion of resource poverty in SMEs. A mere technical adequacey for conducting managerial accounting is insufficient to justify directing personnel or financial resources in that direction. An information system has to satisfy the user in order to be worth the trade-off. It not only needs to have new capabilities, but must also lead to increases in efficiency and effectiveness (see items Satis3 and Satis4).

5.1.4 General Remarks

When looking at the model “from the bottom up”, not only does the degree of novelty increase, but also the amount of unexpected results. Findings for the nine antecedents are congruent with those of Nelson et al. (2005). They appear to be a tested and confirmed foundation for determining IS success, which explain a large amount of the variance in Information Quality and System Quality.

Next “up” comes the part derived and adapted from the DeLone and McLean model. In the two cases where they are comparable, results agree with Petter and McLean’s (2009) meta-analysis as well as with the original study conducted by Kiew and Seddon (1994). Nevertheless, the interpretation of results becomes less obvious. This study cannot definitively explain the lack of significance of the path from Information Quality to Perceived Usefulness. The result may be due a limitation in the estimation method, but not necessarily as the same would have to apply to all other parameters. Furthermore, the predictability of Perceived Usefulness by the other variables is comparatively low, suggesting that there may be other unfluencing factors.

By its very nature, quantitative empirical research cannot give qualitative answers. In order to conclude that the lack of signifiance is not an attribute of the data, qualitative data needs to be collected which is outside the scope of this dissertation. An explanation is pending for future research.

At the “top level” of the model are three benefits that would ensue for conducting managerial accounting if the company deployed an information system. First of all, the predictability is moderate for Reduced Uncertainty, and low for Cost Savings and Better Cooperation. This may be due to the fact that Satisfaction is the only statistically significant predictor. Its influence on the three variables is strong and significant. By contrast, the influence of Perceived Usefulness is low or negative and insignificant. Again, the data does not provide a sufficient answer. A plausible explanation is that the information system needs to provide gains in excess of its costs if employees at SMEs consider the effort worthwhile. This explanation is consistent with the theory of resource poverty, but needs to be tested by another, possibly qualitative investigation.

At this point, the explanatory power of this study runs out of data. Any further attempt at explaining why six out of 20 theoretically feasible hypotheses have to be rejected would be purely speculative. The data does reveal, however, that the satisfaction of users plays a pivotal role in achieving managerial accounting benefits. Together with the many empirically meaningful parameter estimates, the research model does provide a good picture of the interaction of factors contributing to IS success.

5.2 Negative Attitudes in the Survey

Another result of the investigation are the consistently negative attitudes, which respondents have indicated in the questionnaire. Flex3 is the only item with more positive indications (“agree” or “fully agree”) on the answer scale than negative indications (“disagree” or “fully disagree”). The items Comp3 and Coop2 are balanced with means of 3.01 and 3.02, respectively. While the histograms in section 4.3 illustrate the point graphically, the table below

gives the arithmetic mean for each item. A value greater than “3” for the arithmetic mean indicates that more negative answers than positive answers were given.

	Mean	Std. Err.	95% Confidence Interval	
Acc1	3.92	0.06	3.81	4.03
Acc2	3.71	0.07	3.58	3.84
Acc3	3.91	0.05	3.81	4.01
Acc4	3.83	0.07	3.70	3.96
Comp1	3.41	0.07	3.27	3.55
Comp2	3.81	0.06	3.68	3.94
Comp3	3.44	0.07	3.30	3.57
Comp4	3.01	0.08	2.86	3.16
Curr1	3.86	0.06	3.74	3.98
Curr2	3.96	0.06	3.85	4.07
Curr3	3.86	0.06	3.75	3.98
Curr4	3.79	0.06	3.68	3.91
Form1	3.47	0.07	3.35	3.60
Form2	3.60	0.07	3.48	3.73
Form3	3.66	0.07	3.53	3.78
Form4	3.30	0.08	3.15	3.45
Access1	4.03	0.06	3.91	4.14
Access2	3.84	0.06	3.72	3.95
Access3	3.80	0.06	3.67	3.92
Access4	3.68	0.07	3.55	3.81
Rel1	4.04	0.05	3.94	4.14
Rel2	4.00	0.05	3.90	4.10

	Mean	Std. Err.	95% Confidence Interval	
Rel3	4.03	0.05	3.93	4.14
Rel4	3.94	0.05	3.84	4.04
Resp1	3.60	0.08	3.45	3.75
Resp2	3.99	0.05	3.88	4.09
Resp3	3.88	0.06	3.76	3.99
Resp4	3.93	0.06	3.81	4.05
Flex1	3.60	0.07	3.47	3.74
Flex2	3.25	0.07	3.12	3.39
Flex3	2.71	0.07	2.57	2.84
Flex4	3.32	0.08	3.16	3.47
Int1	3.67	0.07	3.54	3.81
Int2	3.89	0.07	3.76	4.02
Int3	3.68	0.07	3.54	3.81
Int4	3.54	0.07	3.41	3.68
Info1	3.81	0.05	3.71	3.92
Info2	3.76	0.06	3.64	3.87
Info3	3.78	0.06	3.66	3.90
Info4	3.20	0.07	3.06	3.34
Sys1	3.79	0.06	3.67	3.90
Sys2	3.78	0.06	3.65	3.91
Sys3	3.83	0.06	3.71	3.95
Sys4	3.61	0.06	3.49	3.73
Use1	4.03	0.06	3.91	4.16
Use2	3.97	0.06	3.85	4.09

	Mean	Std. Err.	95% Confidence Interval	
Use3	4.03	0.06	3.91	4.15
Use4	4.01	0.06	3.89	4.13
Use5	4.06	0.06	3.94	4.18
Use6	4.17	0.05	4.06	4.28
Satis1	3.85	0.06	3.73	3.96
Satis2	3.76	0.06	3.64	3.88
Satis3	3.87	0.06	3.75	3.99
Satis4	3.80	0.06	3.68	3.92
Cost1	3.70	0.06	3.58	3.82
Cost2	3.45	0.07	3.31	3.58
Cost3	3.54	0.07	3.40	3.67
Cost4	3.35	0.07	3.21	3.49
Coop1	3.70	0.06	3.58	3.82
Coop2	3.37	0.07	3.24	3.51
Coop3	3.02	0.07	2.87	3.16
Coop4	3.62	0.07	3.49	3.75
Unc1	3.71	0.06	3.60	3.83
Unc2	4.02	0.05	3.92	4.12
Unc3	3.76	0.06	3.65	3.88
Unc4	3.85	0.06	3.72	3.97

Table 72: Arithmetic means of items.

The outstanding item Flex3 puts forth the following statement: “The IS is versatile in addressing needs as they arise.” That is the only statement to which respondents could agree more than disagree. However, Flex3 also happens to be an item that is reverse coded, which might have confused

some respondents into giving a more favourable answer than they intended. With the exception of the two balanced items, all others on average evoked a negative response. The item with the lowest mean score is Use6: “Overall, I find the IS useful to my job.”

This result is entirely unexpected. In a large, representative sample of German manufacturing firms with more than 50 employees, respondents consistently disagree with positive statements about their IS.

The first thing to verify is the potential influence of response bias, i.e. that this is a sample comprising exclusively the malcontent. Section 4.1.2 investigates reponse bias by looking at wave effects. While late respondents indicate a slightly more positive attitude, the difference is very small. The arithmetic mean for item Comp4 is 2.9 for late respondents, the mean for item Flex3 is obviously smaller than 3 for both subsamples and the mean for item Coop3 is 2.7 for late respondents. However, the following items show a higher mean for late respondents than for early respondents: Acc4, Form2, Form3, Form4, Resp1, Flex1, Flex3, Int4, Use1, Use2, Use3, Use4, Use5, Use6, Satis1, Satis2, Satis3, Info1, Info3, Sys3, Cost3, Unc2, Unc3 and Unc4. In total, 24 out of 66 items have higher means for late respondents. The analysis of response bias does not suggest that only the malcontent responded to the survey.

Respondents’ attitudes cannot just be put down to dissatisfaction (which is measured separately by items Satis1 to Satis4), because the negative responses extend to all variables in the research model, even those referring to technical aspects of the IS. Responses reflect a generally negative assessment of the IS. Furthermore, because the dataset is representative of the relevant population of German companies and the sample appears to be unbiased, this means that respondents’ negative attitudes refer to information systems from a multitude of different vendors. It is after all unreasonable to assume that all respondents use the same system. Among the 177 responses, there is likely to be some diversity.

Of course, the results are not objective measures of the characteristics of an IS. They do, however, reflect the attitudes which people, who use the information systems, have towards them. These people are predominantly managerial accountants, commercial directors, managing directors and CFOs. They are in a position to judge the system and to make decisions about the deployment of an information system for managerial accounting. Why these people indicate such negative attitudes is beyond the power of this study to explain, but certainly calls for an investigation in future research.

6 Implications and Outlook

This chapter concludes the dissertation. It discusses the implication for IS success research and the limitations of the results obtained and of the method of investigation deployed. The second to last section summarises the dissertation in a brief conclusion. Finally, the chapter provides an outlook on those new research questions and topics which have been exposed in the course of the investigation.

6.1 Implications for IS Success Research

This dissertation intends to contribute to the "'cumulative tradition' in I/S" (DeLone & McLean, 1992, p. 88), which was the driving idea behind the original DeLone and McLean model. Over time, that model has been modified several times. The research model therefore incorporates adaptations of prior research as well as some new aspects. Both bear implications for IS success research, either by confirming prior research or by validating new aspects.

The first of these aspects is the adaptation to managerial accounting as the purpose of deploying an IS. Other authors have already applied the rather generic DeLone and McLean model to specific types of systems such as KMS (e.g. Kulkarni, Ravindran, & Freeze, 2007; Wu & Wang, 2006), ERP (e.g. Bernroider, 2008) or e-commerce systems (e.g. DeLone & McLean, 2004; Wang, 2008). The role an information system plays in enabling managerial accounting is a relevant addition. Measuring generic success categories for managerial accounting is often insufficient. (Kron, Parvis-Trevisany, & Schäffer, 2004, p. 6) The three success factors, which are investigated in this dissertation, provide a more differentiated approach and thus render the IS Success Model relevant to the field of managerial accounting as well. Ultimately, managerial accounting research benefits from a tried and tested

success model and IS success research benefits from the application to an additional field.

Another new aspect is the application of IS success research to small and medium sized manufacturing firms in Germany. So far, the model has been tested in a variety of organisations such as universities (McGill et al., 2003; Rai et al., 2002; Seddon & Kiew, 1994), public administration (Gable et al., 2003; Iivari, 2005), the retail industry (Teo & Wong, 1998), Taiwanese top-500 firms (Wu & Wang, 2006) or just a few selected organisations (Nelson et al., 2005; Wang, 2008). The inclusion of a large sample of manufacturing SMEs provides further empirical validation for IS research. Caldeira and Ward (Caldeira & Ward, 2002) pursue a similar approach in their investigation of the "successful adoption and use of IS/IT" at manufacturing SMEs in Portugal, but their research method is based on case studies.

With regard to the confirmation of prior research, most of the paths between constructs are found to be positive and significant. As discussed earlier, these results are congruent with other studies. However, the relationship established in this study between Information Quality and Perceived Usefulness differs from Petter and McLean's (2009) summarising findings. The point has already been discussed in section 5.1.12 but it is still worth comparing these findings to studies which, like this dissertation, are not generic tests of the DeLone and McLean model, but rather adapt it to a specific context. Wang (Wang, 2008, pp. 543-544) looks at e-commerce systems and finds a significant positive relationship between Information Quality and Perceived Value and between Information Quality and User Satisfacation. Wu and Wang (2006, p. 736), who have modified the DeLone and McLean model to an extent which makes it generally difficult to compare it to other models, nevertheless also found a significant (at the 95% level) relationship between Knowledge/Information Quality and User Satisfaction in the context of KMS. These results do not concur with the findings in this dissertation. However, also in the context of KMS, Kulkarni, Ravindran and Freeze (2007, p. 338) fail to find a significant relationship between Knowledge

Content Quality on Perceived Usefulness of Knowledge Sharing for a model that largely follows a KMS process.

Apparently, the relationship between Information Quality and Perceived Usefulness is not established univocally. Even though the presumed positive and significant relationship is feasible theoretically, not all studies find evidence for it. The problem may not apply to all studies, because many stick to the variables Intention to Use and/or Use. While these two variables do not seem to be fully satisfactory predictors of IS success (see section 2.3.2), Petter and McLean (2009, p. 164) find strong support for the relationship of Information Quality to Intention to Use and moderate support for the relationship to Use.

In fact, the reasonable preference for Perceived Usefulness over Use is another implication for IS success research. The inherent problems of Use for determining IS success are outlined in section 2.3.2 and need not be repeated here. As this study provides new data, the arguments either for or against that variable can now draw on both a broader conceptual and empirical basis. Even though the support for Perceived Usefulness turns out to be weak (R^2 and mc^2 of 0.28) in this study, it nevertheless has a noticeable impact on Satisfaction. The conceptual justification remains unimpaired.

In addition, the three benefits Cost Savings, Better Cooperation and Reduced Uncertainty only have Satisfaction as a significant predictor. This kind of mono-causality is certainly not an intended feature of IS success research. As a consequance, R^2 and mc^2 for these variables are comparatively low. Bearing in mind the problems with Perceived Usefulness, it is unclear whether or not the factors in the IS Success Model can be seen as suitable predictors for any kind of Net Benefit. Perhaps there are moderating variables which still have to be discovered in order to improve the overal predictive power of IS success research.

6.2 Limitations

Many limitations to this research have been pointed out during the course of this dissertation. However, two issues warrant special and repeated caution:

While the data obtained from the survey appears to be sound, representative and largely unbiased, its statistical evaluation calls for attention. As discussed in section 4.4.2, ML estimates assume continuous and multivariate normal data. Even though studies by other researchers (e.g. Babakus, Ferguson, & Jöreskog, 1987; Muthén & Kaplan, 1985) support the applicability of ML for this dissertation and results are dependable, conditions are not ideal. The trade-off is between a survey design that is easy to fill in and encourages a comparatively high response rate and the strict abidance to the prerequisites of the statistical estimation method. This dissertation has rather obtained good data instead of running a perfect estimation with a small or incomplete sample. Surely, the applicability of ML is stretched, but not usurped, and results have to be interpreted with that knowledge in mind.

The statistically not significant path from Information Quality to Perceived Usefulness is an example where an interpretation has to be careful. This investigation clearly rejects the related hypothesis that an increase in Information Quality leads to an increase in Perceived Usefulness. But, as discussed before, this may be due to the estimation method. Other studies may obtain different results.

Another statistical limitation are the low R^2 and mc^2 values for Perceived Usefulness, Cost Savings, Better Cooperation and to some extent for Reduced Uncertainty. The research model apparently fails to explain a large portion of variance in these constructs.

The second major limitation is the restriction of the investigation to managerial accounting at small and medium sized manufacturing firms in Germany. While the research is relevant and pertinent for these types of companies, a generalisation to other industries, very large companies or

other countries is difficult. Agourram and Ingham (2007) have investigated differences in perceptions of IS success of users in France, Germany and Canada. Their conclusion is that “the results of our research reveal IS success is not perceived nor defined equally in our group of respondents” (Agourram & Ingham, 2007, p. 651). Consequently, an investigation in IS success in one country cannot readily be extrapolated to other countries.

6.3 Conclusion

The dissertation set out to answer the research question of which factors contribute to an information system’s success at enabling managerial accounting at small and medium sized manufacturing firms in Germany? DeLone and McLean’s model of IS success has been identified as the most suitable basis for the research model. The model has been extended by seven antecedents to Information Quality and System Quality. Use/Intention to Use has been replaced by Perceived Usefulness which has a unidirectional influence on Satisfaction. Cost Savings, Better Cooperation and Reduced Uncertainty have been identified as the three constructs expressing the potential Net Benefits of conducting managerial accounting. The final research model has given rise to 20 research hypotheses which were tested empirically.

An online survey has been conducted among 5,831 small and medium sized manufacturing firms in Germany. They account for approximately half the relevant population. The survey has yielded 177 useful responses which are representative and do not exhibit a strong response bias. A first outcome of the survey was a comparatively high response rate of more than 3% for useful responses. Furthermore, 50% of useful responses were obtained in just over six hours.

Structural equation modelling was used to test the research hypotheses and the research model. Maximum likelihood estimation has yielded parameter estimates and significance levels. Based on the evaluation, six hypotheses had to be rejected: Currency does not have a significant influence on

Information Quality, nor does Response Time on System Quality. More surprisingly, Information Quality does not have a significant influence on Perceived Usefulness. The three Net Benefits Cost Savings, Better Cooperation and Reduced Uncertainty were predicted only by Satisfaction at a statistically significant level. Perceived Usefulness turned out not to have a significant influence on either of the three.

Results for model fit are ambivalent, with some indices indicating a good fit between the research model and the data and some indices indicating poor fit. Furthermore, the model only explains a small part of the variance in Perceived Usefulness, Cost Savings, Better Cooperation and Reduced Uncertainty.

A surprising outcome of the survey was the consistent disagreement of respondents when asked to rate positive statements about their IS. This phenomenon is present in both early and late respondents and thus not due to response bias. Apparently, the vast majority of respondents do not rate highly their information system for conducting mangerial accounting.

Finally, the implications for IS research are discussed. The dissertation has extended research in IS success to the field of managerial accounting at small and medium sized manufacturing firms in Germany. This contributes both to the diversity in IS research (Robey, 1996) and its “cumulative tradition” (DeLone & McLean, 1992, p. 88).

6.4 Outlook

In the light of the results of this investigation, two issues call for further research. The first is the role of Perceived Usefulness in the research model. Why is Information Quality not a significant predictor for it? Why does it not have a significant influence on Net Benefits for managerial accounting, but is mediated through Satisfaction? The second issue is the negative attitudes expressed in the survey. This result was neither predicted nor is it immediately plausible. Its origins can only be speculated upon with the

present data. As with the role of Perceived Usefulness, qualitative empirical research in the form of case studies (Bruns, 1989; Yin, 2009) could complement this quantitative study and discover some explanation for the phenomena. Case study research is established in both IS research (e.g. Benbasat, Goldstein, & Mead, 1987; Myers, 1997) and managerial accounting research (e.g. Otley & Berry, 1998; Scapens, 1990).

While conducting possibly two qualitative studies with uncertain outcome is beyond the scope of this dissertation, such studies would have to comprise several aspects. They have to develop a scientific theory for each of the phenomena. Eisenhardt sees the strength of case study research for building theories in attempting to "reconcile evidence across cases, types of data, and different investigators, and between cases and literature" (1989, p. 546). Furthermore, they need to be designed properly in order to gather relevant data. This comprises a literature review, the definition of the unit of analysis and selecting appropriate cases. (Darke, Shanks, & Broadbent, 1998, pp. 280-281)

Participants in this dissertation's survey cannot be asked to participate in a case study to discuss their results because the questionnaire is completely anonymous. As anonymity has potentially increased the response rate, it has also forecluded the possibility of follow-up interviews. However, as the scope of the survey is very broad, any company that falls within the categorisation of a manufacturing SME would be suitable. The number of cases should be more than one because that would bias the results towards one particular software product in contrast to the general investigation in this dissertation.

The outcome of such qualitative studies would be theories that attempt to explain the role of Perceived Usefulness and of the negative attitudes. Of course, these theories would again be subject to qualitative or quantitative empirical verification. Either way, this dissertation has provided empirical evidence for the factors contributing to an IS success at enabling managerial accounting, but at the same time provided the ground for further research.

List of References

Adam, F., & Fitzgerald, B. (1996). A framework for analysing the evolution of the IS field - can IS become a stable discipline? In *Proceedings of the fourth European conference on information systems* (pp. 17-32).

Adams, D. A., Nelson, R. R., & Todd, P. A. (1992). Perceived usefulness, ease of use, and usage of information technology: A replication. *MIS Quarterly*, *16*(2), 227-247.

Agourram, H., & Ingham, J. (2007). The impact of national culture on the meaning of information system success at the user level. *Journal of Enterprise Information Management*, *20*(6), 641-656.

Ahituv, N., & Neumann, S. (1990). *Principles of information systems for management* (3rd ed.). Dubuque, IA: W.C. Brown Publishers.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, N.J..

Al-Gahtani, S. S., & King, M. (1999). Attitudes, satisfaction and usage: Factors contributing to each in the acceptance of information technology. *Behaviour & Information Technology*, *18*(4), 277-297.

Amadeus. (2012). Retrieved from https://amadeus.bvdinfo.com/ on May 15th, 2012.

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin*, *103*(3), 411-423.

Anthony, R. N., & Govindarajan, V. (2007). *Management control systems* (12th, international ed.). Boston, Mass.: McGraw-Hill.

Armstrong, J. S., & Overton, Terry S. (1977). Estimating nonresponse bias in mail surveys. *Journal of Marketing Research*, *14*(3), 396-402.

Avgerou, C. (2000). Information systems: What sort of science is it? *Omega*, *25*(5), 567–579.

Babakus, E., Ferguson, C. E. J., & Jöreskog, K. G. (1987). The sensitivity of confirmatory maximum likelihood factor analysis to violations of measurement scale and distributional assumptions. *Journal of Marketing Research*, *24*(2), 222-228.

Bagozzi, R. P. (2007). The legacy of the technology acceptance model and a proposal for a paradigm shift. *Journal of the Association of Information Systems*, *8*(4), 244-254.

Bagozzi, R. P., & Yi, Youjae. (2012). Specification, evaluation, and interpretation of structural equation models. *Journal of the Academy of Marketing Science*, *40*(1), 8-34.

Bailey, J. E., & Pearson, S. W. (1983). Developing a tool for measuring and analyzing computer user satisfaction. *Management Science*, *29*(5), 530-545.

Ballantine, J., Bonner, M., Levy, M., Martin, A., Munro, I., & Powell, P. L. (1996). The 3-D model of information systems success: The search for the dependent variable continues. *Information Resources Management Journal*, *9*(4), 5-14.

Benbasat, I., & Barki, H. (2007). Quo vadis, TAM? *Journal of the Association of Information Systems*, *8*(4), 211-218.

Benbasat, I., & Weber, R. (1996). Research commentary: Rethinking "diversity" in information systems research. *Information Systems Research*, *7*(4), 389-399.

Benbasat, I., Goldstein, D. K., & Mead, M. (1987). The case research strategy in studies of information systems. *MIS Quarterly*, *11*(3), 369-386.

Benjamin, R. I. (1982). Information technology in the 1990s: A long range planning scenario. *MIS Quarterly*, *6*(2), 11-31.

Bentler, P. M. (1980). Multivariate analysis with latent variables: Causal modeling. *Annual Review of Psychology*, *31*, 419-456.

Bentler, P. M., & Dudgeon, P. (1996). Covariance structure analysis: Statistical practice, theory, and directions. *Annual Review of Psychology*, *47*(1), 563-92.

Bentler, P. M., & Raykov, T. (2000). On measures of explained variance in nonrecursive structural equation models. *Journal of Applied Psychology*, *85*(1), 125-131.

Berekoven, L., Eckert, W., & Ellenrieder, P. (2004). *Marktforschung: Methodische Grundlagen und Praktische Anwendungen* (10th ed.). Wiesbaden.

Bernroider, E. (2008). IT governance for enterprise resource planning supported by the DeLone–McLean model of information systems success. *Information & Management*, *45*(5), 257-269.

Berry, A. J., Broadbent, J., & Otley, D. (2005). Accounting systems and control. In J. Broadbent, D. Otley, & A. J. Berry (Eds.), *Management control: Theories, issues and performance* (2nd ed.) (pp. 99-121). Houndmills: Palgrave Macmillan.

Boudreau, M., Gefen, D., & Straub, D. W. (2001). Validation in information systems research: A state-of-the-art assessment. *MIS Quarterly*, *25*(1), 1-16.

Bruns, J. J. (1989). A review of Robert K. Yin's case study research: Design and methods. *Journal of Management Accounting Research*, *1*, 157.

Bruns, W. J. J., & McKinnon, S. M. (1993). Information and managers: A field study. *Journal of Management Accounting Research*, *5*, 84-108.

Bullock, H., Harlow, L., & Mulaik, S. (1994). Causation issues in structural equation modeling research. *Structural Equation Modeling: A Multidisciplinary Journal*, *1*(3), 253-267.

Butler, A., Letza, S. R., & Neale, N. (1997). Linking the balanced scorecard to strategy. *Long Range Planning*, *30*(2), 242-253.

Caldeira, M. M., & Ward, J. M. (2002). Understanding the successful adoption and use of IS/IT in SMEs: An explanation from Portuguese manufacturing industries. *Information Systems Journal*, *12*(2), 121-152.

Chen, C.-W. (2010). Impact of quality antecedents on taxpayer satisfaction with online tax-filing systems: An empirical study. *Information & Management*, *47*(5-6), 308-315.

Chin, W. W., & Todd, P. A. (1995). On the use, usefulness, and ease of use of structural equation modeling in MIS research: A note of caution. *MIS Quarterly*, *19*(2), 237-246.

Chou, Chih-Ping, & Bentler, Peter M. (1995). Estimates and tests in structural equation modeling. In Hoyle, Rick H. (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 37-55). Thousand Oaks: Sage Publications.

Cliff, N. (1983). Some cautions concerning the application of causal modeling methods. *Multivariate Behavioral Research*, *18*(1), 115-126.

Couper, M. P., Traugott, M. W., & Lamias, M. J. (2001). Web survey design and administration. *Public Opinion Quarterly*, *65*(2), 230-253.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*(3), 297-334.

Darke, P., Shanks, G., & Broadbent, M. (1998). Successfully completing case study research: Combining rigour, relevance and pragmatism. *Information Systems Journal*, *8*(4), 273-289.

Davis, F. D. (1985). *A technology acceptance model for empirically testing new end-user information systems: Theory and results.* Thesis,

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319-340.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, *35*(8), 982-1003.

Davis, G. B. B., & Olson, M. H. (1985). *Management information systems, conceptual foundations, structure and development* (2nd ed.). New York: McGraw-Hill.

DeLone, W. H. (1988). Determinants of success for computer usage in small business. *MIS Quarterly*, *12*(1), 51-61.

DeLone, W. H., & McLean, E. R. (1992). Information systems success: The quest for the dependent variable. *Information Systems Research*, *3*(1), 60-95.

DeLone, W. H., & McLean, E. R. (2002). Information systems success revisited. In *Proceedings of the 35th annual Hawaii international conference on system sciences* (pp. 238-48).

DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Infomation Systems*, *19*(4), 9-30.

DeLone, W. H., & McLean, E. R. (2004). Measuring e-commerce success: Applying the DeLone & McLean information systems success model. *International Journal of Electronic Commerce*, *9*(1), 31-47.

Destatis. (2011). Unternehmensregister. Retrieved from https://www.destatis.de/DE/ZahlenFakten/GesamtwirtschaftUmwelt/UnternehmenHandwerk/Unternehmensregister/Tabellen/UnternehmenBeschaeftigtengroessenklassenWZ08.html?nn=50670 on May 14th, 2012.

Destatis. (2012). *Beschäftigte und Umsatz der Betriebe im verarbeitenden Gewerbe: Deutschland, Jahre, Beschäftigtengrößenklassen, Wirtschaftszweige* (WZ2008 2-/3-/4-Steller). Wiesbaden.

Deyhle, A. (1993). Controlling-Entwicklung von innen heraus. In K. Liessmann (Ed.), *Controlling-Konzepte für den Mittelstand: Existenzsicherung durch Innovation und Flexibilität* (pp. 37-55). Freiburg i. Br.: Rudolf Haufe Verlag.

Dieter Rams. (2012). Retrieved from http://en.wikipedia.org/wiki/Dieter_Rams on March 4th, 2012.

Doornik, Jurgen A., & Hansen, Henrik. (2008). An omnibus test for univariate and multivariate normality. *Oxford Bulletin of Economics & Statistics*, *70*, 927-939.

Drury, D. H., & Farhoomand, A. F. (1998). A hierarchical structural model of information systems success. *INFOR, 36(1/2)*, 25-40

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review*, *14*(4), 532-550.

European Commission. (2012). The new SME definition: User guide and model declaration. Retrieved from http://ec.europa.eu/enterprise/policies/sme/files/sme_definition/sme_user_guide_en.pdf on May 2nd, 2012.

Feuerhake, J., & Bundil, M. (2007). Aufwendungen und Investitionen in Informations- und Kommunikationstechnologien. *Wirtschaft und Statistik*, (6), 556-566.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research.* Reading, Mass.: Addison-Wesley.

Fornell, C., & Bookstein, F. L. (1982). Two structural equation models: LISREL and PLS applied to consumer exit-voice theory. *Journal of Marketing Research*, *19*(4), 440-452.

Gable, G. G., Sedera, D., & Chan, T. (2003). Enterprise systems success: A measurement model. In *Proceedings of the twenty-fourth international conference on information systems* (pp. 576-91).

Gable, G. G., Sedera, D., & Chan, T. (2008). Re-conceptualizing information system success: The IS-impact measurement model. *Journal of the Association of Information Systems*, *9*(7), 377-408.

Garrity, E. J., & Sanders, G. L. (1998). *Information systems success measurement*. Hershey, London.

Gefen, D., Straub, D. W., & Boudreau, M. (2000). Structural equation modeling and regression: Guidelines for research practice. *Communications of the AIS*, *4*(7), 1-79.

Gelderman, M. (1998). The relation between user satisfaction, usage of information systems and performance. *Information & Management*, *34*(1), 11-18.

Ginzberg, M. J. (1981). Early diagnosis of MIS implementation failure: Promising results and unanswered questions. *Management Science*, *27*(4), 459-478.

Goldenberger, A. S. (1973). Structural equation models: An overview. In O. D. Duncan & A. S. Goldberger (Eds.), *Structural equation models in the social sciences* (pp. 1-18). New York, London: Seminar Press.

Goodhue, D. L. (1998). Development and measurement validity of a task-technology fit instrument for user evaluations of information system. *Decision Sciences*, *29*(1), 105-138.

Goodhue, D. L., & Thompson, R. L. (1995). Task-Technology fit and individual performance. *MIS Quarterly*, *19*(2), 213-236.

Guimaraes, T. (1984). The benefits and problems of user computing. *Information Systems Management*, *1*(4), 3-9.

Guimaraes, T., & Ramanujam, V. (1986). Personal computing trends and problems: An empirical study. *MIS Quarterly*, *10*(2), 179-187.

Hahn, D. (1982). The control function in major german companies. *Long Range Planning*, *15*(3), 21-50.

Hamilton, L. C., & Stata, S. (2011). *Stata release 12*. College Station (Tex.): Stata Press.

Hansen, H. R., & Neumann, G. (2002). *Wirtschaftsinformatik I: Grundlagen betrieblicher Informationsverarbeitung* (8th ed.). Stuttgart: Lucius & Lucius.

Heidmann, M., Schäffer, U., & Strahringer, S. (2008). Exploring the role of management accounting systems in strategic sensemaking. *Information Systems Management*, *25*(3), 244-257.

Henze, N., & Zirkler, B. (1990). A class of invariant consistent tests for multivariate normality. *Communications in Statistics - Theory and Methods*, *19*(10), 3595-3617.

Hicks, J. O. (1993). *Management information systems: A user perspective* (3rd ed.). Minneapolis/St. Paul: West Pub. Co.

Horngren, C. T. (2004). Management accounting: Some comments. *Journal of Management Accounting Research*, *16*, 207-211.

Hoyle, R. H. (1995). The structural equation modeling approach: Basic concepts and fundamental issues. In Hoyle, Rick H. (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 1-15). Thousand Oaks: Sage.

Hoyle, R. H., & Panter, A. T. (1995). Writing about structural equation models. In Hoyle, Rick H. (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 158-76). Thousand Oaks: Sage.

Hsiu-Fen, L., & Gwo-Guang, L. (2006). Determinants of success for online communities: An empirical study. *Behaviour & Information Technology*, *25*(6), 479-488.

Ibrahim, A. B., & Goodwin, J. R. (1987). Perceived causes of success in small business. *American Journal of Small Business*, *11*(2), 41-51.

IfM. (2007). *Die volkswirtschaftliche Bedeutung der Familienunternehmen*. Institut für Mittelstandsforschung, Bonn.

IfM. (2012). KMU-Definition des Ifm Bonn. Retrieved from http://www.ifm-bonn.org/index.php?id=89 on May 2nd, 2012.

Iivari, J. (2005). An empirical test of the DeLone-McLean model of information system success. *Data Base for Advances in Information Systems*, *36*(2), 8-27.

Internationaler Controller Verein. (2005). *Was ist Controlling?*. [Pamphlet] Internationaler Controller Verein.

Ishman, M. (1998). Measuring information success at the individual level in cross-cultural environments. In G. L. Sanders & E. J. Garrity (Eds.), *Information systems success measurement* (pp. 60-78). Hershey, London.

Ives, B., Olson, M. H., & Baroudi, J. J. (1983). The measurement of user information satisfaction. *Communications of the ACM*, *26*(10), 785-793.

Jacoby, J., & Matell, M. S. (1971). Three-point Likert scales are good enough. *Journal of Marketing Research*, *8*(4), 495-500.

Jöreskog, K. G. (1969). A general approach to confirmatory maximum likelihood factor analysis. *Psychometrika*, *34*(2), 183-202.

Jöreskog, K. G. (1973). A general model for estimating a linear structural equation system. In O. D. Duncan & A. S. Goldberger (Eds.), *Structural equation models in the social sciences* (pp. 85-112). New York, London: Seminar Press.

Jöreskog, K. G., & Sörbom, D. (1982). Recent developments in structural equation modeling. *Journal of Marketing Research*, *19*(4), 404-416.

Kaplan, R. S., & Norton, D. P. (1993). Putting the balanced scorecard to work. *Harvard Business Review*, *71*(5), 134-147.

Kaplan, R. S., & Norton, D. P. (1996a). *The balanced scorecard: Translating strategy into action*. Boston, Mass.: Harvard Business School Press.

Kaplan, R. S., & Norton, D. P. (1996b). Using the balanced scorecard as a strategic management tool. *Harvard Business Review*, *74*(1), 75-85.

Kaplan, R. S., & Norton, D. P. (2005). The balanced scorecard: Measures that drive performance. *Harvard Business Reivew*, *83*(7), 172-180.

Kim, K. S., Knotts, T. L., & Jones, S. C. (2008). Characterizing viability of small manufacturing enterprises (SME) in the market. *Expert Systems with Applications*, *34*(1), 128-134.

Kline, Rex B. (2011). *Principles and practice of structural equation modeling* (3rd ed.). New York: The Guilford Press.

Kosmider, A. (1991). *Controlling im Mittelstand: Eine Untersuchung der Gestaltung und Anwendung des Controllings in mittelständischen Industrieunternehmen*. Stuttgart: C.E. Poeschel.

Krämer, W. (2003). *Mittelstandsökonomik : Grundzüge einer umfassenden Analyse kleiner und mittlerer Unternehmen*. München: Vahlen.

Krämmler-Burrak, A., Sasse, A., & Hofmann, N. D. (2006). Ausbau des Rechnungswesens zu einem management accounting. In Horváth & Partners (Ed.), *Das Controllingkonzept: Der weg zu einem wirkungsvollen Controllingsystem* (6th ed.) (pp. 89-156).

Kron, R. G., Parvis-Trevisany, N., & Schäffer, U. (2004). *Zum Erfolg der Implementierung von Controllinginstrumenten.* European Business School Working Paper on Management Accounting & Control No. 13.

Kulkarni, U. R., Ravindran, S., & Freeze, R. (2007). A knowledge management success model: Theoretical development and empirical validation. *Journal of Management Information Systems*, *23*(3), 309-347.

Küpper, H. (1997). *Controlling-Konzepte: Controlling: Konzeption, Aufgaben und Instrumente* (2nd ed.). Stuttgart: Schäffer-Poeschel.

Küpper, H., Weber, J., & Zünd, A. (1990). Zum Verständnis und Selbstverständnis des Controlling: Thesen zur Konsensbildung. *Zeitschrift Für Betriebswirtschaft*, *60*(3), 281-293.

Lee, Y., Kozar, K. A., & Larsen, K. R. T. (2003). The technology acceptance model: Past, present, and future. *Communications of the AIS*, *12*, 752-780.

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & Management*, *40*(3), 191-204.

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology*, *22*(140), 3-55.

Lohr, M. (2012). Specificities of managerial accounting at SMEs: Case studies from the German industrial sector. *Journal of Small Business and Entrepreneurship*, *25*(1), 35-56.

Lucas, H. C. (1989). *Methodological issues in information systems survey research.* In *Information Systems Working Papers Series: New york.*

Manegold, D., Steinle, C., & Krummaker, S. (2007). *Controlling in kleinen und mittleren Unternehmungen*. Saarbrücken: VDM Verlag Dr. Müller.

Mardia, K. V. (1970). Measures of multivariate skewness and kurtosis with applications. *Biometrika*, *57*(3), 519-530.

Mason, R. (1978). Measuring information output: A communication systems approach. *Information & Management*, *1*(4), 219-234.

McDonald, H., & Adam, S. (2003). A comparison of online and postal data collection methods in marketing research. *Marketing Intelligence & Planning*, *21*(2), 85-95.

McGill, T., Hobbs, V., & Klobas, J. (2003). User-Developed applications and information systems success: A test of DeLone and McLean's model. *Information Resources Management Journal*, *16*(1), 24-45.

McKelvie, S. J. (1978). Graphic rating scales - how many categories? *British Journal of Psychology*, *69*(2), 185-202.

McKinney, V., Kanghyun, Y., & Zahedi, F. (2002). The measurement of web-customer satisfaction: An expectation and disconfirmation approach. *Information Systems Research*, *13*(3), 296-315.

Mockler, R. J. (1970). The corporate control job: Breaking the mold: The function has broadened - and will broaden more. *Business Horizons*, *13*(6), 73-77.

Molla, A., & Licker, P. S. (2001). E-commerce systems success: An attempt to extend and respecify the DeLone and McLean model of IS success. *Journal of Electronic Commerce Research*, *2*(4), 131-141.

Mueller, R. O. (1996). *Basic principles of structural equation modeling - an introduction to LISREL and EQS*. New York, Berlin, Heidelberg.

Muthén, B., & Kaplan, D. (1985). A comparison of some methodologies for the factor analysis of nonnormal liker variables: A note on the size of the model. *British Journal of Mathematical and Statistical Psychology*, *38*, 171-189.

Myers, B. L., Kappelman, L. A., & Prybutok, V. R. (1997). A comprehensive model for assessing the quality and productivity of the information systems function: Toward a theory for information systems assessment. *Information Resources Management Journal*, *10*(1), 6-25.

Myers, M. D. (1997). Qualitative research in information systems. *MIS Quarterly*, *21*(2), 241-242.

Neely, A., Bourne, M., & Adams, C. (2003). Better budgeting or beyond budgeting? *Measuring Business Excellence*, *7*(3), 22-28.

Nelson, R. R., Todd, P. A., & Wixom, B. H. (2005). Antecedents of information and system quality: An empirical examination within the context of data warehousing. *Journal of Management Information Systems*, *21*(4), 199-235.

Niedermayr, R. (1994). *Edition Österreichisches Controller-Institut: Entwicklungsstand des Controlling: System, Kontext und Effizienz*. Wiesbaden: Deutscher Universitäts-Verlag.

Nooteboom, B. (1988). The facts about small business and the real values of its 'life world': A social philosophical interpretation of this sector of the modem economy. *American Journal of Economics and Sociology*, *47*(3), 299-314.

Nooteboom, Bart. (1996). Trust, opportunism and governance: A process and control model. *Organization Studies*, *17*(6), 985-1010.

Osterman, P. (1991). Impact of IT on jobs and skills. In M. S. S. Morton (Ed.), *The corporation of the 1990s: Information technology and organizational transformation* (pp. 220-43). Oxford, New York, Toronto.

Otley, D. (1994). Management control in contemporary organizations: Towards a wider framework. *Management Accounting Research*, *5*(3-4), 289-299.

Otley, D. T., & Berry, A. J. (1998). Case study research in management accounting and control. *Accounting Education*, *7*, 105-127.

Petter, S., & McLean, E. R. (2009). A meta-analytic assessment of the DeLone and McLean IS success model: An examination of IS success at the individual level. *Information & Management*, *46*(3), 159-166.

Petter, S., DeLone, W. H., & McLean, E. R. (2008). Measuring information systems success: Models, dimensions, measures, and interrelationships. *European Journal of Information Systems*, *17*(3), 236–263.

Pietsch, G., & Scherm, E. (2000). Die Präzisierung des Controlling als Führungs- und Führungsunterstützungsfunktion. *Die Unternehmung*, *54*(5), 395-411.

Pitt, L. F., Watson, R. T., & Kavan, C. B. (1995). Service quality: A measure of information systems effectiveness. *MIS Quarterly*, *19*(2), 173-187.

Plümecke, M. (2006). *Konzepte der Budgetierung: Beyond budgeting, better budgeting: Grundlagen, Potenzial, Praxis*. Saarbrücken: VDM-Verlag Müller.

Premkumar, G., & Bhattacherjee, A. (2008). Explaining information technology usage: A test of competing models. *Omega*, *36*(1), 64-75.

Rai, A., Lang, S. S., & Welker, R. B. (2002). Assessing the validity of IS success models: An empirical test and theoretical analysis. *Information Systems Research*, *13*(1), 50-69.

Rand, Paul. (2012). The politics of design. Retrieved from http://www.paul-rand.com/foundation/thoughts_politics/#.T09rbVHR3Hg on March 1st, 2012.

Rickards, R. C. (2006). Beyond budgeting: Boon or boondoggle? *Investment Management and Financial Innovations*, *3*(2), 62-76.

Ring, Peter Smith, & van de Ven, Andrew H. (1992). Structuring cooperative relationships between organizations. *Strategic Management Journal*, *13*(7), 483-498.

Robey, D. (1996). Research commentary: Diversity in information systems research: Threat, promise, and responsibility. *Information Systems Research*, *7*(4), 400-408.

Saeed, K. A., & Abdinnour-Helm, S. (2008). Examining the effects of information system characteristics and perceived usefulness on post adoption usage of information systems. *Information & Management*, *45*(6), 376-386.

Scapens, R. W. (1990). Researching management accounting practice: The role of case study methods. *The British Accounting Review*, *22*(3), 259-281.

Schäffer, U. (2001). Controlling, Controller und Kontrolle. In U. Schäffer & J. Weber (Eds.), *Schriften des Center for Controlling & Management (CCM): Vol. 2. Rationalitätssicherung der Führung. Beiträge zu einer Theorie des Controlling* (pp. 122-30). Wiesbaden: Deutscher Universitäts-Verlag.

Schwarz, N. (1999). Self-reports: How the questions shape the answers. *American Psychologist*, *54*(2), 93-105.

Schwarz, N., Hippler, H., Noelle-Neumann, E., & Clark, L. (1991). Rating scales: Numeric values may change the meaning of scale labels. *Public Opinion Quarterly*, *55*(4), 570-582.

Seddon, P. B. (1997). A respecification and extension of the DeLone and McLean model of IS success. *Information Systems Research*, *8*(3), 240-253.

Seddon, P. B., & Kiew, M. (1994). A partial test and development of the DeLone and McLean model of IS success. In *ICIS 1994 proceedings* (pp. 99-110).

Seddon, P. B., & Yip, S. (1992). An empirical evaluation of user information satisfaction (UIS) measures for use with general ledger accounting software. *Journal of Information Systems*, *6*(1), 75-92.

Seddon, P. B., Graeser, V., & Willcocks, L. P. (2002). Measuring organizational IS effectiveness: An overview and update of senior management perspectives. *Data Base for Advances in Information Systems*, *33*(2), 11-28.

Seddon, P. B., Staples, D. S., Patnayakuni, R., & Bowtell, M. J. (1998). The IS effectiveness matrix: The importance of stakeholder and system in measuring IS success. In *ICIS 1998 proceedings* (pp. 165-76).

Seddon, P. B., Staples, S., Patnayakuni, R., & Bowtell, M. (1999). Dimensions of information systems success. *Communications of the AIS*, *2*(2), 1-40.

Sedera, D., & Gable, G. (2004). A factor and structural equation analysis of the enterprise systems success measurement model. In *Proceesings of the twenty-fifth international conference on information systems* (pp. 449-64).

Shannon, C. E., & Weaver, W. (1963). *The mathematical theory of communication*. Urbana and Chicago.

Silver, M. S., Markus, M. L., & Beath, C. M. (1995). The information technology interaction model: A foundation for the MBA core course. *MIS Quarterly*, *19*(3), 361-390.

Sipior, J. C., Ward, B. T., & Wagner, W. P. (1998). Is it time to consider legal liability in system success measurement? In L. G. Sanders & E. J. Garrity (Eds.), *Information systems success measurement* (pp. 79-93). Hershey, London: Idea Group Publishing.

Snitkin, S. R., & King, W. R. (1986). Determinants of the effectiveness of personal decision support systems. *Information & Management*, *10*(2), 83-89.

Soh, C. P., Yap, C. S., & Raman, K. S. (1992). Impact of consultants on computerization success in small businesses. *Information & Management*, *22*(5), 309-319.

SoSci Survey. (2012). Retrieved from www.soscisurvey.de on January 10th, 2012.

Spearman, C. (1904). The proof and measurement of association between two things. *The American Journal of Psychology*, *15*(1), 72-101.

Straub, D. W. (1989). Validating instruments in MIS research. *MIS Quarterly*, *12*(2), 147-169.

Straub, D. W., Boudreau, M., & Gefen, D. (2004). Validation guidelines for IS positivist research. *Communications of the AIS*, *13*, 380-427.

Swanson, E. B., & Ramiller, N. C. (1993). Information systems research thematics: Submissions to a new journal, 1987-1992. *Information Systems Research*, *4*(4), 299-330.

Teo, T. S. H., & Wong, P. K. (1998). An empirical study of the performance impact of computerization in the retail industry. *Omega*, *26*(5), 611-621.

Toepoel, V., Das, M., & Soest, A. V. (2009). Design of web questionnaires: The effect of layout in rating scales. *Journal of Official Statistics*, *25*(4), 509-528.

Truell, A. D., Bartlett, J. E., & Alexander, M. W. (2002). Response rate, speed, and completeness: A comparison of internet-based and mail surveys. *Behavior Research Methods, Instruments, & Computers*, *34*(1), 46-49.

Urbach, N., Smolnik, S., & Riempp, G. (2010). An empirical investigation of employee portal success. *The Journal of Strategic Information Systems*, *19*(3), 184-206.

van Goor, H., & van Goor, A. (2007). The usefulness of the basic question procedure for determining non-response bias in substantive variables. *International Journal of Market Research*, *49*(2), 221-236.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186-204.

Venkatesh, V., Davis, F. D., & Morris, M. G. (2007). Dead or alive? The development, trajectory and future of technology adoption research. *Journal of the Association of Information Systems*, *8*(4), 267-286.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425-478.

Wang, Y. (2008). Assessing e-commerce systems success: A respecification and validation of the DeLone and McLean model of IS success. *Information Systems Journal*, *18*(5), 529-557.

Weber, J. (2004). *Sammlung Poeschel: Einführung in das Controlling* (10th ed.). Stuttgart: Schäffer-Poeschel.

Weber, J., & Schäffer, U. (1999). Sicherstellung der Rationalität von Führung als Aufgabe des Controlling? *Die Betriebswirtschaft*, *59*(6), 731-746.

Weber, J., Schäffer, U., & Prenzler, C. (2001). Charakterisierung und Entwicklung von Controlleraufgaben. In J. Weber & U. Schäffer (Eds.), *Rationalitätssicherung der Führung: Beitrage zu einer Theorie des Controlling* (pp. 131-51). Wiesbaden: Deutscher Universitäts-Verlag.

Weber, U. (2001). Neue Perspektiven des Controlling. In U. Schäffer & J. Weber (Eds.), *Schriften des Center for Controlling & Management (CCM): Vol. 2. Rationalitätssicherung der Führung. Beiträge zu einer Theorie des Controlling* (pp. 152-70). Wiesbaden: Deutscher Universitäts-Verlag.

Welsh, J. A., & White, J. F. (1981). A small business is not a little big business. *Harvard Business Review*, *59*(4), 1-12.

West, Stephen G., Finch, John F., & Curran, Patrick J. (1995). Structural equation models with nonnormal variables: Problems and remedies. In Hoyle, Rick H. (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 56-75). Thousand Oaks: Sage Publications.

Wixom, B. H., & Todd, P. A. (2005). A theoretical integration of user satisfaction and technology acceptance. *Information Systems Research*, *16*(1), 85-102.

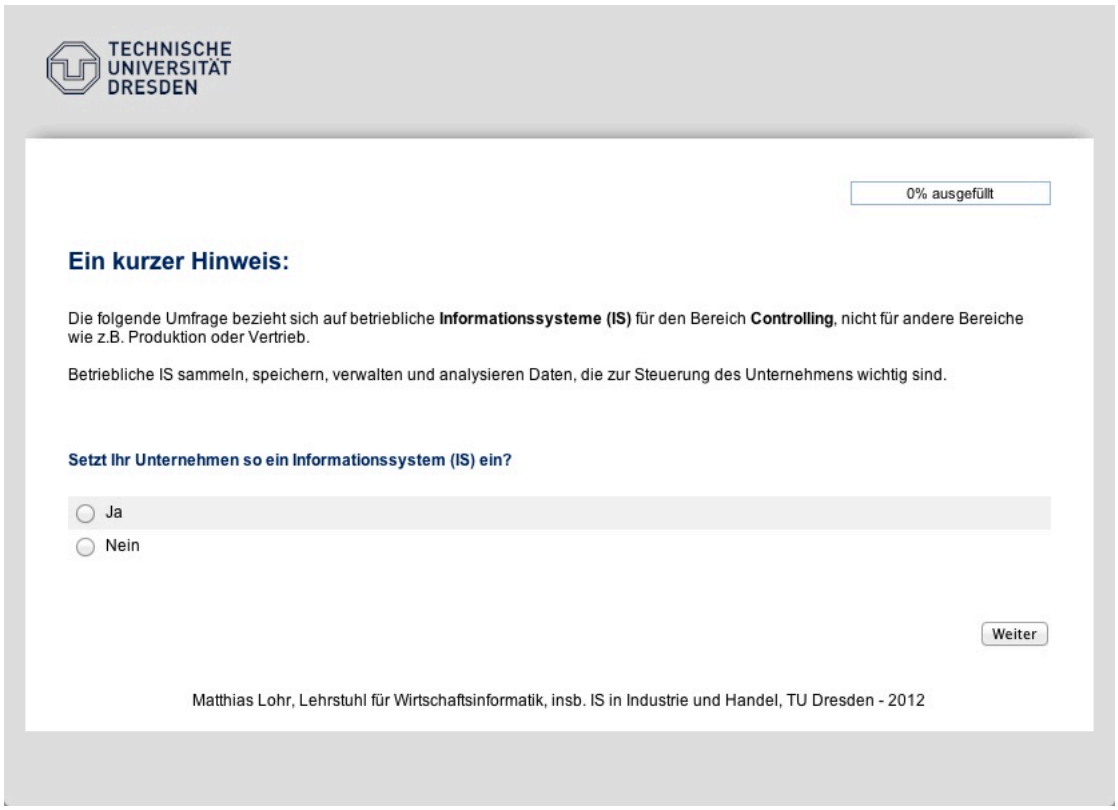
Wu, J., & Wang, Y. (2006). Measuring KMS success: A respecification of the DeLone and McLean's model. *Information & Management*, *43*(6), 728-739.

Yin, R. K. (2009). *Case study research: Design and methods*. Los Angeles, Calif.: Sage Publications.

Zmud, R. W. (1978). An empirical investigation of the dimensionality of the concept of information. *Decision Sciences*, *9*(2), 187-195.

Appendix

A1 Questionnaire



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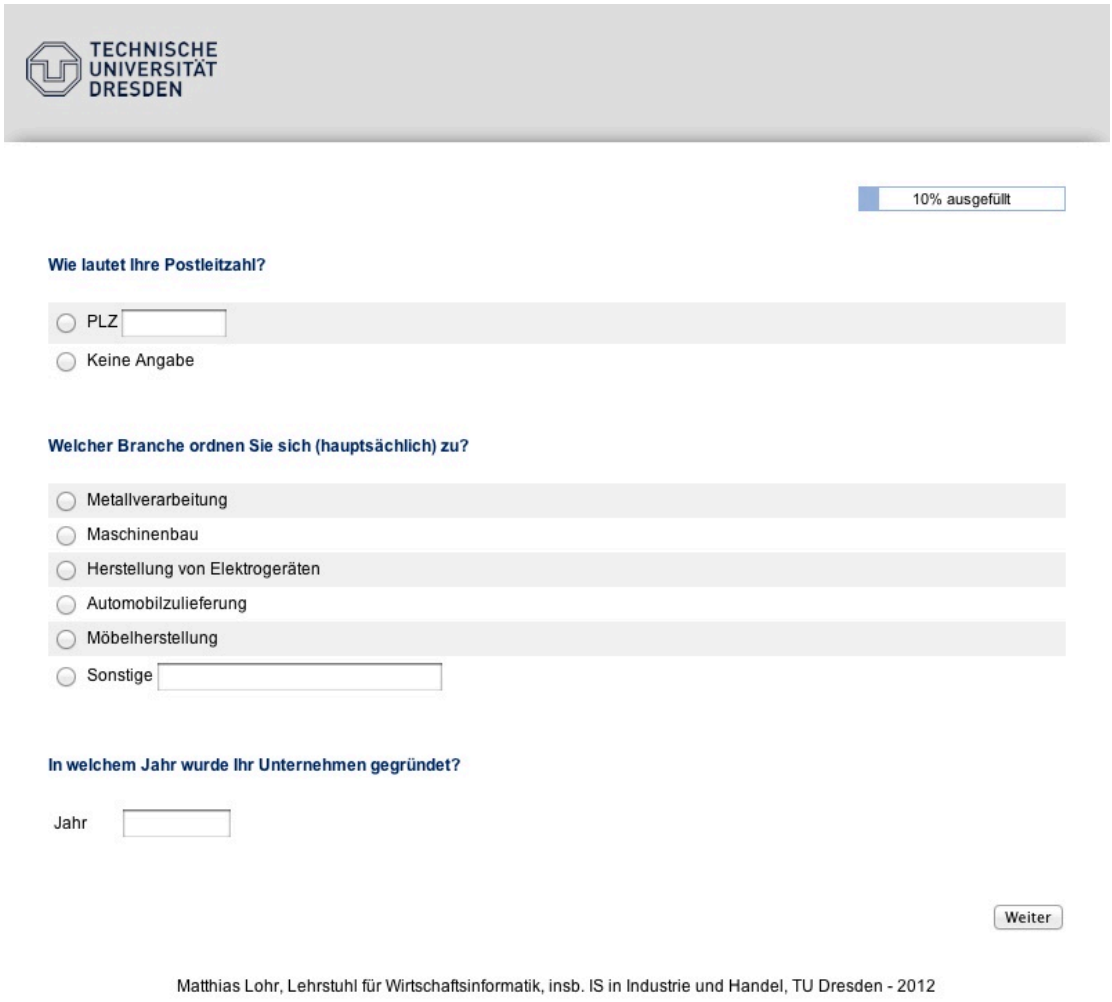

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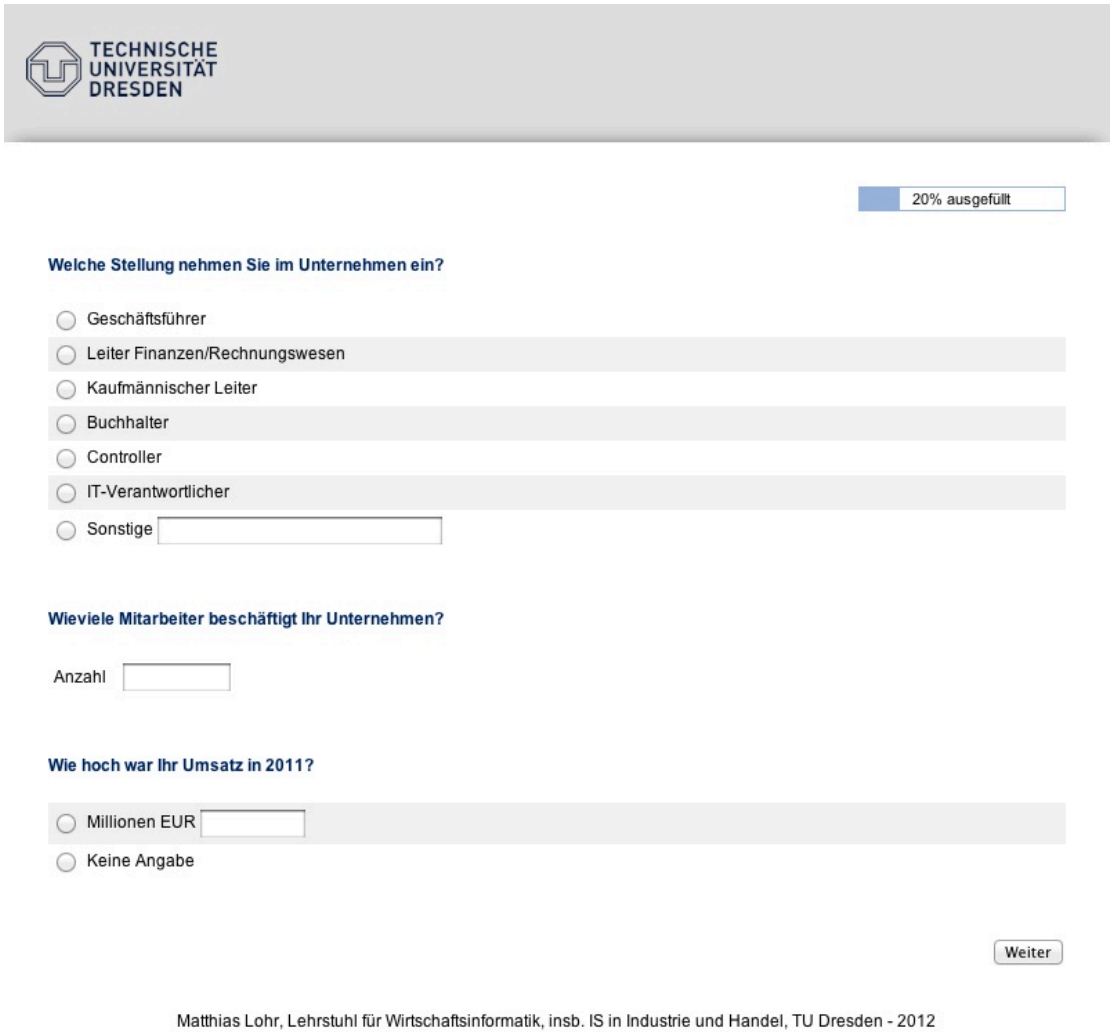

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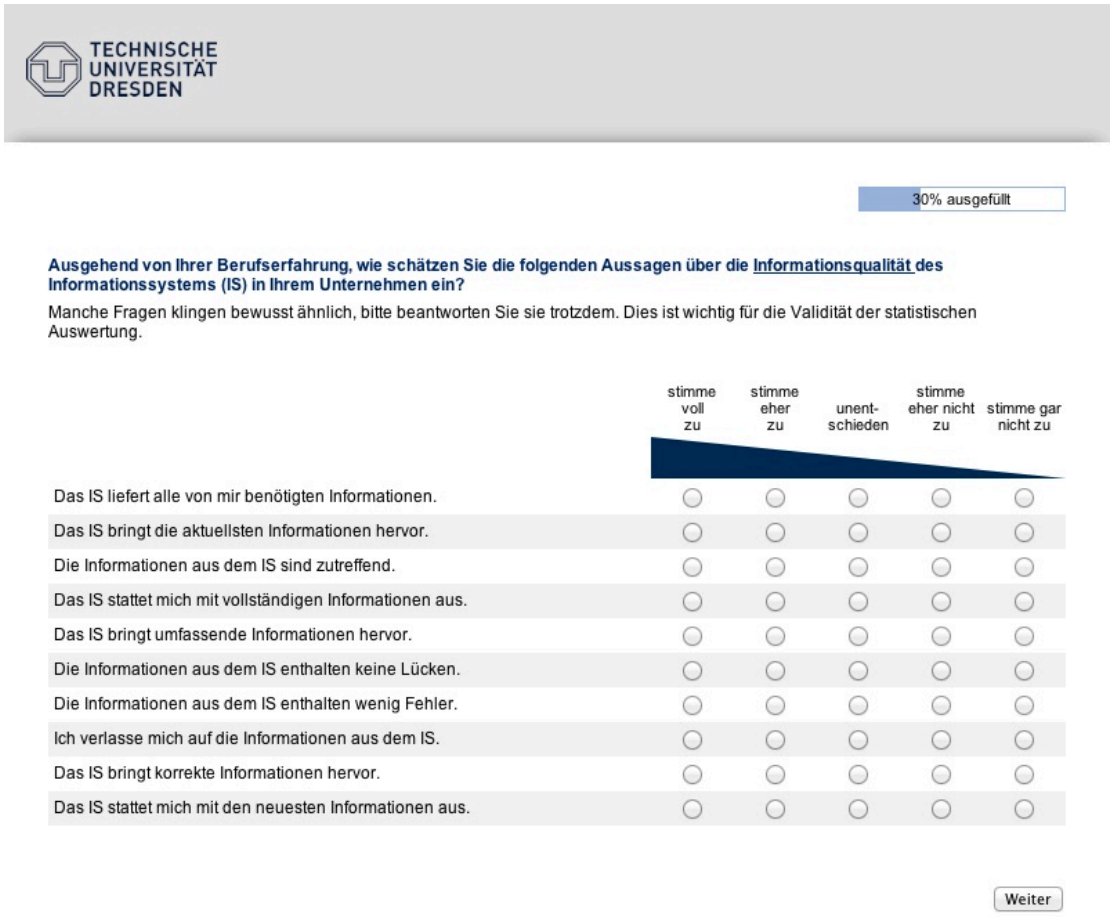

TECHNISCHE UNIVERSITÄT DRESDEN

30% ausgefüllt

Ausgehend von Ihrer Berufserfahrung, wie schätzen Sie die folgenden Aussagen über die Informationsqualität des Informationssystems (IS) in Ihrem Unternehmen ein?

Manche Fragen klingen bewusst ähnlich, bitte beantworten Sie sie trotzdem. Dies ist wichtig für die Validität der statistischen Auswertung.

	stimme voll zu	stimme eher zu	unent-schieden	stimme eher nicht zu	stimme gar nicht zu
Das IS liefert alle von mir benötigten Informationen.	○	○	○	○	○
Das IS bringt die aktuellsten Informationen hervor.	○	○	○	○	○
Die Informationen aus dem IS sind zutreffend.	○	○	○	○	○
Das IS stattet mich mit vollständigen Informationen aus.	○	○	○	○	○
Das IS bringt umfassende Informationen hervor.	○	○	○	○	○
Die Informationen aus dem IS enthalten keine Lücken.	○	○	○	○	○
Die Informationen aus dem IS enthalten wenig Fehler.	○	○	○	○	○
Ich verlasse mich auf die Informationen aus dem IS.	○	○	○	○	○
Das IS bringt korrekte Informationen hervor.	○	○	○	○	○
Das IS stattet mich mit den neuesten Informationen aus.	○	○	○	○	○

Weiter

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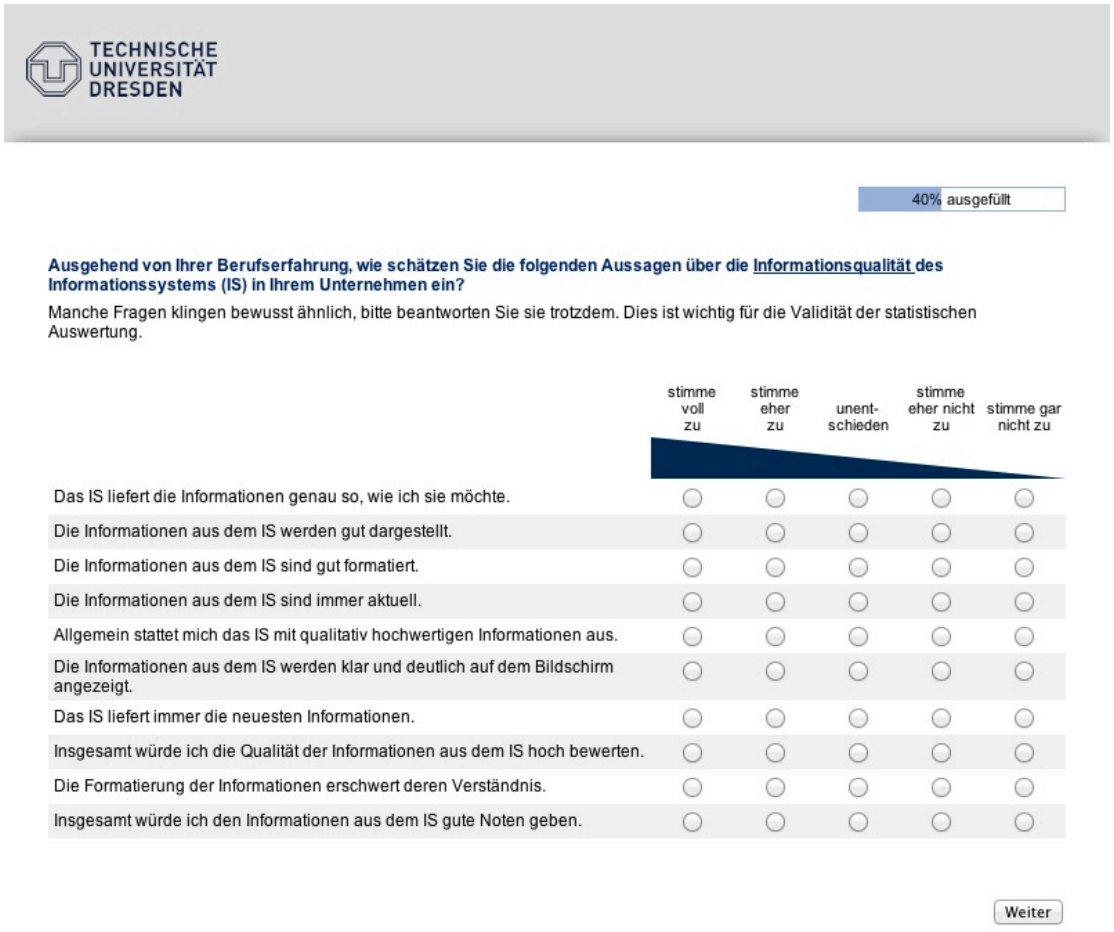

TECHNISCHE UNIVERSITÄT DRESDEN

40% ausgefüllt

Ausgehend von Ihrer Berufserfahrung, wie schätzen Sie die folgenden Aussagen über die Informationsqualität des Informationssystems (IS) in Ihrem Unternehmen ein?

Manche Fragen klingen bewusst ähnlich, bitte beantworten Sie sie trotzdem. Dies ist wichtig für die Validität der statistischen Auswertung.

	stimme voll zu	stimme eher zu	unent-schieden	stimme eher nicht zu	stimme gar nicht zu
Das IS liefert die Informationen genau so, wie ich sie möchte.	○	○	○	○	○
Die Informationen aus dem IS werden gut dargestellt.	○	○	○	○	○
Die Informationen aus dem IS sind gut formatiert.	○	○	○	○	○
Die Informationen aus dem IS sind immer aktuell.	○	○	○	○	○
Allgemein stattet mich das IS mit qualitativ hochwertigen Informationen aus.	○	○	○	○	○
Die Informationen aus dem IS werden klar und deutlich auf dem Bildschirm angezeigt.	○	○	○	○	○
Das IS liefert immer die neuesten Informationen.	○	○	○	○	○
Insgesamt würde ich die Qualität der Informationen aus dem IS hoch bewerten.	○	○	○	○	○
Die Formatierung der Informationen erschwert deren Verständnis.	○	○	○	○	○
Insgesamt würde ich den Informationen aus dem IS gute Noten geben.	○	○	○	○	○

Weiter

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TECHNISCHE UNIVERSITÄT DRESDEN

50% ausgefüllt

Ausgehend von Ihrer Berufserfahrung, wie schätzen Sie die folgenden Aussagen über die Systemqualität des Informationssystems (IS) in Ihrem Unternehmen ein?

Manche Fragen klingen bewusst ähnlich, bitte beantworten Sie sie trotzdem. Dies ist wichtig für die Validität der statistischen Auswertung.

	stimme voll zu	stimme eher zu	unent-schieden	stimme eher nicht zu	stimme gar nicht zu
Zugriff auf die Informationen im IS ist einfach.	○	○	○	○	○
Das IS antwortet sofort auf meine Abfragen.	○	○	○	○	○
Es kann leicht auf Informationen im IS zugegriffen werden.	○	○	○	○	○
Das IS liefert Informationen zeitnah.	○	○	○	○	○
Der Betrieb des IS ist zuverlässig.	○	○	○	○	○
Das IS gewährt mir schnellen Zugriff auf seine Daten.	○	○	○	○	○
Es dauert zu lang, bis das IS auf meine Abfragen reagiert.	○	○	○	○	○
Das IS arbeitet zuverlässig.	○	○	○	○	○
Die Leistung des IS ist zuverlässig.	○	○	○	○	○
Das IS gibt schnell Antworten auf meine Abfragen zurück.	○	○	○	○	○
Ich kann mich auf die Leistungsfähigkeit des IS verlassen.	○	○	○	○	○
Das IS macht Informationen gut zugänglich.	○	○	○	○	○

Weiter

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TECHNISCHE UNIVERSITÄT DRESDEN

60% ausgefüllt

Ausgehend von Ihrer Berufserfahrung, wie schätzen Sie die folgenden Aussagen über die Systemqualität des Informationssystems (IS) in Ihrem Unternehmen ein?

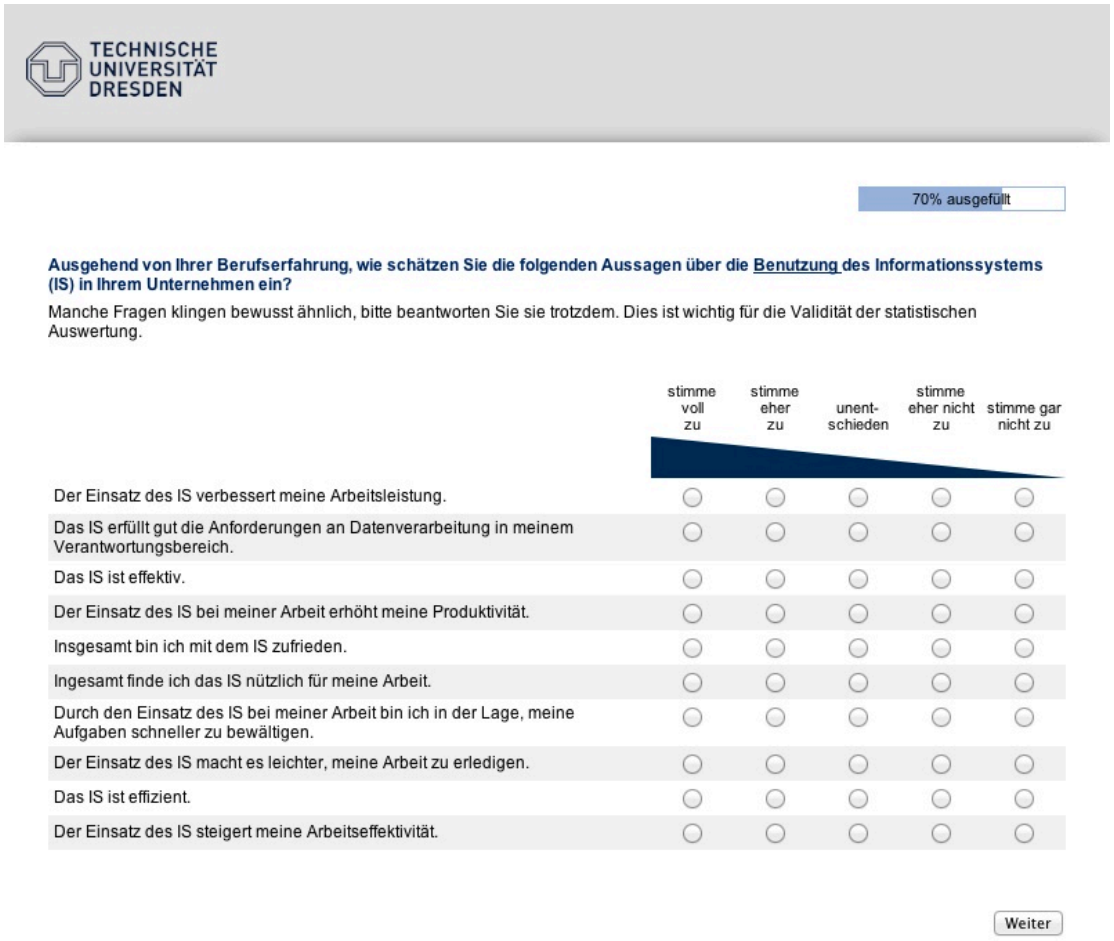
Manche Fragen klingen bewusst ähnlich, bitte beantworten Sie sie trotzdem. Dies ist wichtig für die Validität der statistischen Auswertung.

	stimme voll zu	stimme eher zu	unent-schieden	stimme eher nicht zu	stimme gar nicht zu
Ingesamt ist das IS von hoher Qualität.	○	○	○	○	○
Insgesamt ist das IS gut mit anderen Systemen im Unternehmen integriert.	○	○	○	○	○
Das IS kann auf vielfältige Bedarfe angepasst werden.	○	○	○	○	○
Das IS ist auf einen bestimmten Funktionsumfang begrenzt.	○	○	○	○	○
Im Hinblick auf die Systemqualität würde ich das IS hoch bewerten.	○	○	○	○	○
Das IS integriert wirkungsvoll Daten aus verschiedenen Unternehmensbereichen.	○	○	○	○	○
Ingesamt würde ich die Qualität des IS hoch bewerten.	○	○	○	○	○
Das IS kann vielseitig auf neu entstehende Bedürfnisse eingehen.	○	○	○	○	○
Das IS führt Informationen zusammen, die ansonsten aus verschiedenen Unterenehmensbereichen kommen.	○	○	○	○	○
Das IS kann sich flexibel auf neue Anforderungen oder Bedingungen anpassen.	○	○	○	○	○
Das IS kombiniert wirkungsvoll Daten aus verschiedenen Unternehmensbereichen.	○	○	○	○	○
Das IS läuft gemäß meinen Erwartungen.	○	○	○	○	○

Weiter

Matthias Lohr, Lehrstuhl für Wirtschaftsinformatik, insb. IS in Industrie und Handel, TU Dresden - 2012

Page 7 of the questionnaire.



TECHNISCHE UNIVERSITÄT DRESDEN

70% ausgefüllt

Ausgehend von Ihrer Berufserfahrung, wie schätzen Sie die folgenden Aussagen über die Benutzung des Informationssystems (IS) in Ihrem Unternehmen ein?

Manche Fragen klingen bewusst ähnlich, bitte beantworten Sie sie trotzdem. Dies ist wichtig für die Validität der statistischen Auswertung.

	stimme voll zu	stimme eher zu	unent-schieden	stimme eher nicht zu	stimme gar nicht zu
Der Einsatz des IS verbessert meine Arbeitsleistung.	○	○	○	○	○
Das IS erfüllt gut die Anforderungen an Datenverarbeitung in meinem Verantwortungsbereich.	○	○	○	○	○
Das IS ist effektiv.	○	○	○	○	○
Der Einsatz des IS bei meiner Arbeit erhöht meine Produktivität.	○	○	○	○	○
Insgesamt bin ich mit dem IS zufrieden.	○	○	○	○	○
Ingesamt finde ich das IS nützlich für meine Arbeit.	○	○	○	○	○
Durch den Einsatz des IS bei meiner Arbeit bin ich in der Lage, meine Aufgaben schneller zu bewältigen.	○	○	○	○	○
Der Einsatz des IS macht es leichter, meine Arbeit zu erledigen.	○	○	○	○	○
Das IS ist effizient.	○	○	○	○	○
Der Einsatz des IS steigert meine Arbeitseffektivität.	○	○	○	○	○

Weiter

Matthias Lohr, Lehrstuhl für Wirtschaftsinformatik, insb. IS in Industrie und Handel, TU Dresden - 2012

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TECHNISCHE UNIVERSITÄT DRESDEN

80% ausgefüllt

Ausgehend von Ihrer Berufserfahrung, wie schätzen Sie die folgenden Aussagen über die Vorteile des Informationssystems (IS) in Ihrem Unternehmen ein?

Manche Fragen klingen bewusst ähnlich, bitte beantworten Sie sie trotzdem. Dies ist wichtig für die Validität der statistischen Auswertung.

	stimme voll zu	stimme eher zu	unent-schieden	stimme eher nicht zu	stimme gar nicht zu
Das IS verbessert die Zusammenarbeit unter Mitarbeitern.	○	○	○	○	○
Das IS verringert das Risiko, eine falsche Entscheidung zu treffen.	○	○	○	○	○
Der Einsatz des IS ermöglicht es dem Unternehmen kosteneffizienter zu arbeiten.	○	○	○	○	○
Ingesamt verbessert das IS die Zusammenarbeit im Unternehmen.	○	○	○	○	○
Ingesamt senkt das IS die im Unternehmen verursachten Kosten.	○	○	○	○	○
Das IS hilft unnötige Kosten zu senken.	○	○	○	○	○
Ingesamt erhöht das IS die Transparenz über das Unternehmensumfeld.	○	○	○	○	○
Durch den Einsatz des IS kann ich Quellen von Verschwendung identifizieren.	○	○	○	○	○
Das IS erleichtert die Zusammenarbeit.	○	○	○	○	○
Das IS ermöglicht es mir, zutreffende Voraussagen zu treffen.	○	○	○	○	○
Dank des IS können Mitarbeiter gezielter auf die Fähigkeiten ihrer Kollegen zurückgreifen.	○	○	○	○	○
Das IS liefert relevante Informationen für die Entscheidungsfindung.	○	○	○	○	○

Weiter

Matthias Lohr, Lehrstuhl für Wirtschaftsinformatik, insb. IS in Industrie und Handel, TU Dresden - 2012

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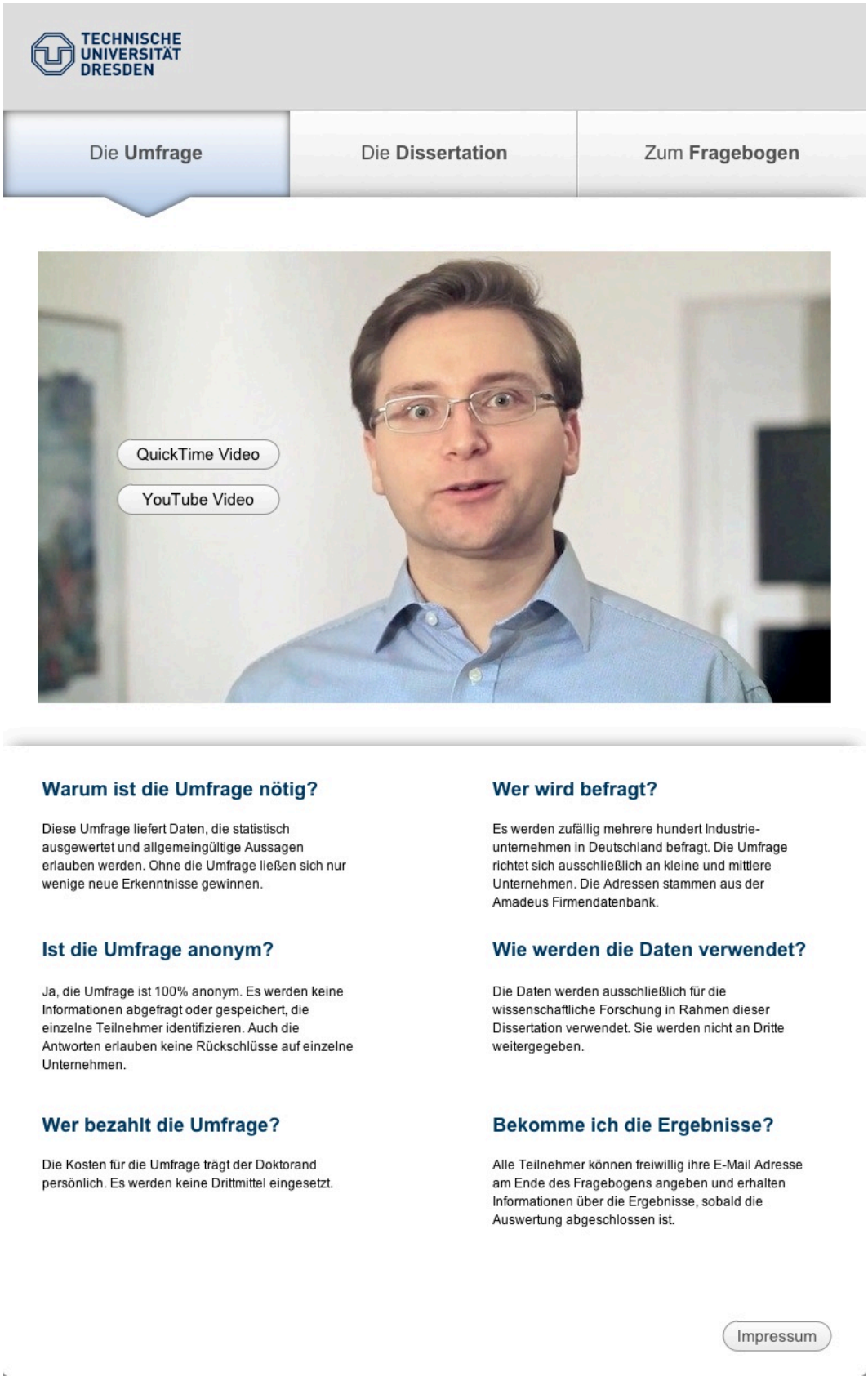
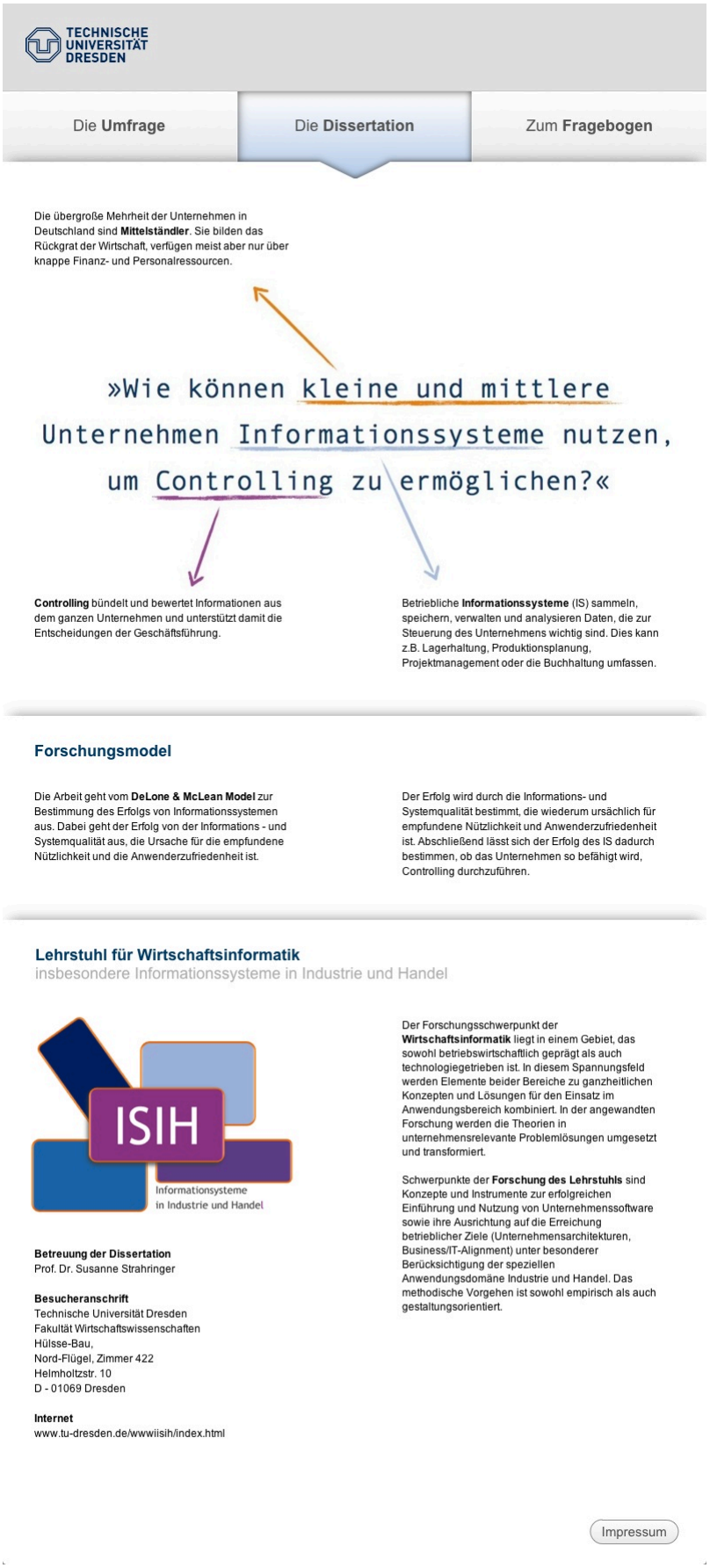
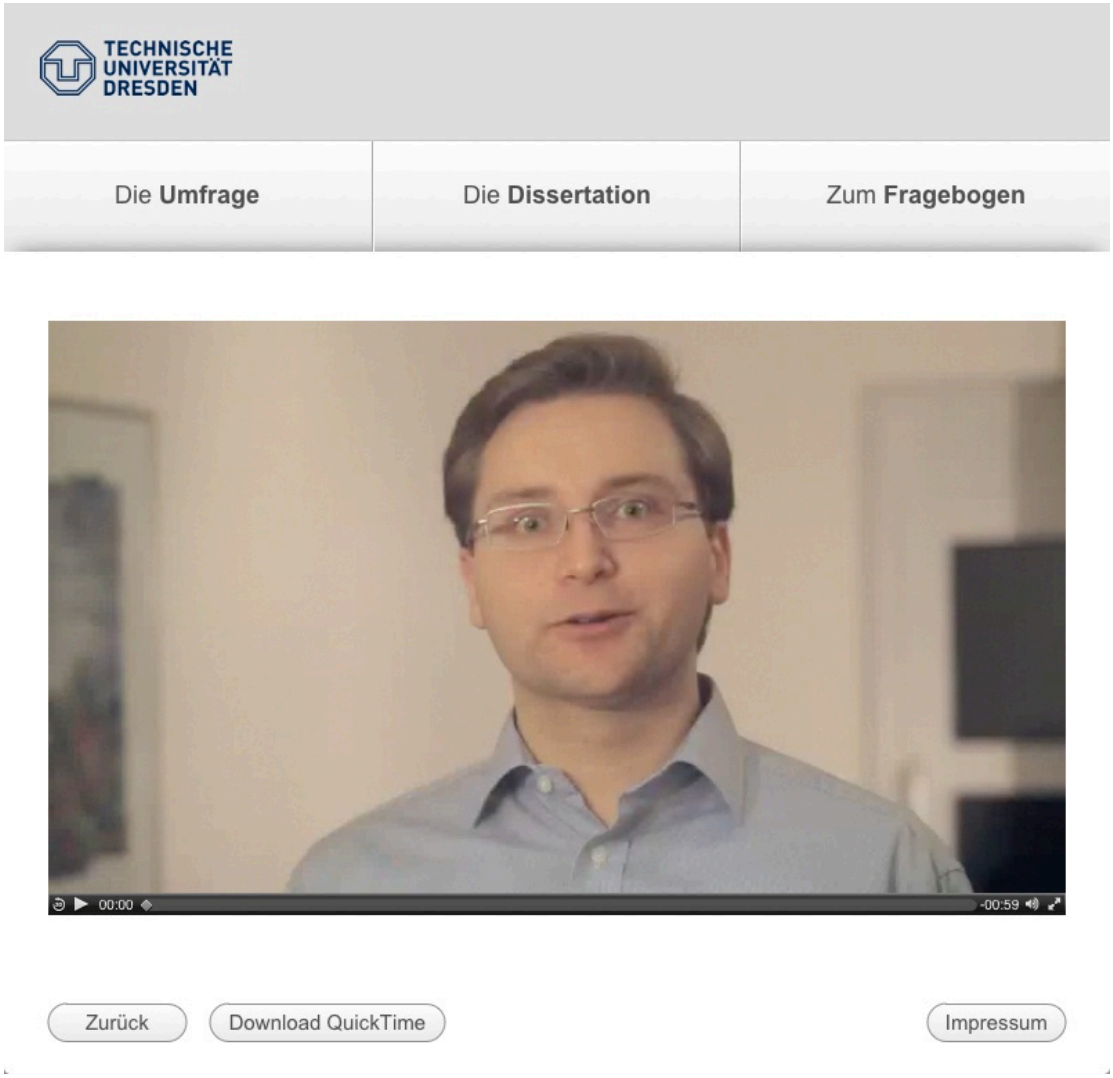
A2 Website



Page 1 of the website.



Page 2 of the website.



QuickTime page of the website.

A3 Free Text Responses to Industry

- Industrieelektronik, Industrieautomation
- Komponenten für Elektrotechnik
- Hörgeräteakustiker-Handwerk
- Rohrleitungsbau
- Rapid prototyping
- Optische Datenträger / Mikrofunktionelle Strukturen
- Brandschutz
- Medizinprodukte
- Elektronik
- Telekommunikation
- Medizintechnik
- Elektronik
- Kranleistungen und Montagen
- Verarbeitung Papier u. Kunststoff
- Mess und Regeltechnik
- Herstellung von Messgeräten
- Herstellung von elektrotechnischen Komponenten
- elektronische Bauelemente
- Baunebengewerbe
- Schiffbau
- Metallerzeugung
- Fensterherstellung
- Industriedienstleistungen
- Chemie / Produktion
- Anlagenbau
- Werkzeugbau
- Messtechnik Herstellung
- Elektronik
- Anlagenbau
- Bau
- Anlagenbau
- Photovoltaik
- Luftfahrt
- Umwelt
- Großhandel
- Bauelemente
- Gesundheitswesen
- Hersteller von Lithiumbatterien
- ITK
- elektrotechnische Anlagen und Steuerungen
- Anlagenbau
- Entwicklung und Herstellung Meßgeräte und Software
- Elektronikdienstleistung

A4 Wave Effects

		D	P-Value	Corrected	Mean
Acc1	**Late**	0.0126	0.9910		3.9
	Early	-0.0032	0.9990		3.9
	Combined	0.0126	1.0000	1.0000	
Acc2	**Late**	0.1326	0.3890		3.6
	Early	-0.0732	0.7500		3.7
	Combined	0.1326	0.7330	0.6580	
Acc3	**Late**	0.0574	0.8380		3.9
	Early	-0.0152	0.9880		3.9
	Combined	0.0574	1.0000	1.0000	
Acc4	**Late**	0.0019	1.0000		3.9
	Early	-0.0922	0.6340		3.8
	Combined	0.0922	0.9770	0.9620	
Comp1	**Late**	0.0777	0.7230		3.3
	Early	-0.0145	0.9890		3.4
	Combined	0.0777	0.9970	0.9940	
Comp2	**Late**	0.0833	0.6890		3.7
	Early	-0.0139	0.9900		3.8
	Combined	0.0833	0.9920	0.9860	
Comp3	**Late**	0.2500	0.0350		3.0
	Early	0.0000	1.0000		3.5
	Combined	0.2500	0.0700	0.0450	
Comp4	**Late**	0.0745	0.7420		2.9

		D	P-Value	Corrected	Mean
	Early	0.0000	1.0000		3.0
	Combined	0.0745	0.9980	0.9970	
Curr1	**Late**	0.0499	0.8750		3.8
	Early	-0.0069	0.9970		3.9
	Combined	0.0499	1.0000	1.0000	
Curr2	**Late**	0.0783	0.7200		3.8
	Early	-0.0069	0.9970		4.0
	Combined	0.0783	0.9970	0.9940	
Curr3	**Late**	0.1067	0.5430		3.8
	Early	-0.0114	0.9930		3.9
	Combined	0.1067	0.9200	0.8830	
Curr4	**Late**	0.1168	0.4810		3.6
	Early	-0.0069	0.9970		3.8
	Combined	0.1168	0.8570	0.8030	
Form1	**Late**	0.0941	0.6220		3.4
	Early	-0.0751	0.7390		3.5
	Combined	0.0941	0.9710	0.9540	
Form2	**Late**	0.0631	0.8070		3.7
	Early	-0.1288	0.4100		3.6
	Combined	0.1288	0.7650	0.6940	
Form3	**Late**	0.0442	0.9000		3.7
	Early	-0.0473	0.8870		3.6
	Combined	0.0473	1.0000	1.0000	
Form4	**Late**	0.0259	0.9650		3.4

		D	P-Value	Corrected	Mean
	Early	-0.0732	0.7500		3.3
	Combined	0.0732	0.9990	0.9980	
Access1	**Late**	0.0619	0.8140		4.0
	Early	-0.0183	0.9820		4.0
	Combined	0.0619	1.0000	1.0000	
Access2	**Late**	0.1553	0.2740		3.6
	Early	-0.0360	0.9330		3.9
	Combined	0.1553	0.5370	0.4510	
Access3	**Late**	0.1742	0.1960		3.7
	Early	-0.0524	0.8630		3.8
	Combined	0.1742	0.3890	0.3100	
Access4	**Late**	0.2121	0.0890		3.5
	Early	-0.0663	0.7900		3.7
	Combined	0.2121	0.1780	0.1280	
Rel1	**Late**	0.0663	0.7900		4.0
	Early	-0.0713	0.7610		4.0
	Combined	0.0713	0.9990	0.9990	
Rel2	**Late**	0.1572	0.2650		3.8
	Early	-0.0177	0.9830		4.0
	Combined	0.1572	0.5210	0.4350	
Rel3	**Late**	0.1199	0.4620		4.0
	Early	-0.0739	0.7460		4.0
	Combined	0.1199	0.8350	0.7760	
Rel4	**Late**	0.0852	0.6770		3.9

		D	P-Value	Corrected	Mean
	Early	-0.0593	0.8280		4.0
	Combined	0.0852	0.9900	0.9820	
Resp1	**Late**	0.0095	0.9950		3.8
	Early	-0.1035	0.5620		3.6
	Combined	0.1035	0.9360	0.9040	
Resp2	**Late**	0.1364	0.3680		3.9
	Early	-0.0341	0.9400		4.0
	Combined	0.1364	0.7000	0.6220	
Resp3	**Late**	0.1648	0.2330		3.8
	Early	-0.0688	0.7750		3.9
	Combined	0.1648	0.4600	0.3760	
Resp4	**Late**	0.0947	0.6180		3.8
	Early	-0.0271	0.9610		3.9
	Combined	0.0947	0.9700	0.9520	
Flex1	**Late**	0.1080	0.5350		3.6
	Early	-0.0638	0.8040		3.6
	Combined	0.1080	0.9130	0.8740	
Flex2	**Late**	0.1761	0.1890		3.2
	Early	-0.0379	0.9260		3.3
	Combined	0.1761	0.3760	0.2970	
Flex3	**Late**	0.0518	0.8660		2.8
	Early	-0.1528	0.2860		2.7
	Combined	0.1528	0.5580	0.4720	
Flex4	**Late**	0.1275	0.4180		3.3

		D	P-Value	Corrected	Mean
	Early	-0.0524	0.8630		3.3
	Combined	0.1275	0.7750	0.7060	
Int1	**Late**	0.1048	0.5540		3.5
	Early	-0.0057	0.9980		3.7
	Combined	0.1048	0.9300	0.8960	
Int2	**Late**	0.1124	0.5080		3.8
	Early	-0.0436	0.9030		3.9
	Combined	0.1124	0.8870	0.8400	
Int3	**Late**	0.0467	0.8890		3.6
	Early	-0.0038	0.9990		3.7
	Combined	0.0467	1.0000	1.0000	
Int4	**Late**	0.0164	0.9860		3.6
	Early	-0.0777	0.7230		3.5
	Combined	0.0777	0.9970	0.9940	
Info1	**Late**	0.0000	1.0000		3.9
	Early	-0.0568	0.8410		3.8
	Combined	0.0568	1.0000	1.0000	
Info2	**Late**	0.0928	0.6300		3.7
	Early	-0.0707	0.7650		3.8
	Combined	0.0928	0.9750	0.9590	
Info3	**Late**	0.0044	0.9990		3.9
	Early	-0.0732	0.7500		3.8
	Combined	0.0732	0.9990	0.9980	
Info4	**Late**	0.0903	0.6460		3.1

		D	P-Value	Corrected	Mean
	Early	-0.0795	0.7120		3.2
	Combined	0.0903	0.9810	0.9680	
Sys1	**Late**	0.0556	0.8470		3.7
	Early	-0.0126	0.9910		3.8
	Combined	0.0556	1.0000	1.0000	
Sys2	**Late**	0.0448	0.8980		3.8
	Early	-0.0593	0.8280		3.8
	Combined	0.0593	1.0000	1.0000	
Sys3	**Late**	0.0461	0.8920		3.9
	Early	-0.1338	0.3820		3.8
	Combined	0.1338	0.7220	0.6460	
Sys4	**Late**	0.1420	0.3380		3.5
	Early	-0.0215	0.9760		3.6
	Combined	0.1420	0.6510	0.5690	
Use1	**Late**	0.0215	0.9760		4.2
	Early	-0.1742	0.1960		4.0
	Combined	0.1742	0.3890	0.3100	
Use2	**Late**	0.0354	0.9350		4.0
	Early	-0.0366	0.9310		4.0
	Combined	0.0366	1.0000	1.0000	
Use3	**Late**	0.0455	0.8950		4.1
	Early	-0.1206	0.4580		4.0
	Combined	0.1206	0.8300	0.7700	
Use4	**Late**	0.0013	1.0000		4.1

		D	P-Value	Corrected	Mean
	Early	-0.1275	0.4180		4.0
	Combined	0.1275	0.7750	0.7060	
Use5	**Late**	0.0120	0.9920		4.2
	Early	-0.1370	0.3650		4.0
	Combined	0.1370	0.6950	0.6160	
Use6	**Late**	0.0259	0.9650		4.2
	Early	-0.0884	0.6570		4.2
	Combined	0.0884	0.9850	0.9740	
Satis1	**Late**	0.0530	0.8600		3.8
	Early	-0.0455	0.8950		3.8
	Combined	0.0530	1.0000	1.0000	
Satis2	**Late**	0.0000	1.0000		3.9
	Early	-0.1174	0.4770		3.7
	Combined	0.1174	0.8530	0.7980	
Satis3	**Late**	0.0600	0.8240		3.9
	Early	-0.0991	0.5900		3.9
	Combined	0.0991	0.9550	0.9300	
Satis4	**Late**	0.0903	0.6460		3.8
	Early	-0.0436	0.9030		3.8
	Combined	0.0903	0.9810	0.9680	
Cost1	**Late**	0.1559	0.2710		3.4
	Early	0.0000	1.0000		3.8
	Combined	0.1559	0.5310	0.4460	
Cost2	**Late**	0.1547	0.2770		3.3

		D	P-Value	Corrected	Mean
	Early	-0.0240	0.9700		3.5
	Combined	0.1547	0.5420	0.4560	
Cost3	**Late**	0.0170	0.9850		3.7
	Early	-0.1319	0.3930		3.5
	Combined	0.1319	0.7380	0.6640	
Cost4	**Late**	0.1130	0.5040		3.2
	Early	-0.0518	0.8660		3.4
	Combined	0.1130	0.8830	0.8350	
Coop1	**Late**	0.2165	0.0810		3.5
	Early	0.0000	1.0000		3.8
	Combined	0.2165	0.1610	0.1140	
Coop2	**Late**	0.1199	0.4620		3.1
	Early	0.0000	1.0000		3.4
	Combined	0.1199	0.8350	0.7760	
Coop3	**Late**	0.1907	0.1420		2.7
	Early	-0.0120	0.9920		3.1
	Combined	0.1907	0.2830	0.2150	
Coop4	**Late**	0.1610	0.2490		3.4
	Early	0.0000	1.0000		3.7
	Combined	0.1610	0.4900	0.4050	
Unc1	**Late**	0.0372	0.9280		3.7
	Early	-0.0530	0.8600		3.7
	Combined	0.0530	1.0000	1.0000	
Unc2	**Late**	0.0593	0.8280		4.1

		D	P-Value	Corrected	Mean
	Early	-0.1155	0.4880		4.0
	Combined	0.1155	0.8660	0.8140	
Unc3	**Late**	0.0208	0.9770		3.8
	Early	-0.0499	0.8750		3.8
	Combined	0.0499	1.0000	1.0000	
Unc4	**Late**	0.0158	0.9870		3.9
	Early	-0.0619	0.8140		3.8
	Combined	0.0619	1.0000	1.0000	

Kolmogorov-Smirnov tests for late and early respondents and arithmetic means.

A5 Univariate Normality Tests for Original Items

			Joint	
	Pr(Skewness)	**Pr(Kurtosis)**	**adj $\chi^2(2)$**	**Pr > χ^2**
Acc1	0.0006	0.1431	11.8500	0.0027
Acc2	0.0013	0.9109	9.1900	0.0101
Acc3	0.0113	0.1928	7.5100	0.0235
Acc4	0.0001	0.1220	14.5000	0.0007
Comp1	0.0169	0.1005	7.7400	0.0209
Comp2	0.0000	0.0748	16.3900	0.0003
Comp3	0.0103	0.7608	6.3800	0.0412
Comp4	0.9035	0.0129	6.0000	0.0498
Curr1	0.0031	0.1883	9.3400	0.0094
Curr2	0.0002	0.0158	16.1600	0.0003
Curr3	0.0064	0.1429	8.6300	0.0133
Curr4	0.0033	0.1496	9.5000	0.0087
Form1	0.0598	0.6667	3.7800	0.1512
Form2	0.0005	0.2645	11.3800	0.0034
Form3	0.0001	0.1220	15.5000	0.0004
Form4	0.1145	0.0089	8.4600	0.0146
Access1	0.0008	0.2897	10.7800	0.0046
Access2	0.0002	0.1606	13.4300	0.0012
Access3	0.0025	0.8930	8.3200	0.0156
Access4	0.0289	0.6087	5.6000	0.0797
Rel1	0.0257	0.1078	7.8000	0.0290
Rel2	0.0123	0.0832	8.4100	0.0149

			Joint	
	Pr(Skewness)	**Pr(Kurtosis)**	**adj $\chi^2(2)$**	**Pr > χ^2**
Rel3	0.0017	0.1309	10.5800	0.0050
Rel4	0.0243	0.1109	7.1200	0.0284
Resp1	0.0034	0.2772	8.7700	0.0124
Resp2	0.0037	0.1504	9.3300	0.0094
Resp3	0.0110	0.6248	6.4000	0.0408
Resp4	0.0001	0.0638	15.2500	0.0005
Flex1	0.0091	0.9094	6.5000	0.0388
Flex2	0.6733	0.0249	5.2000	0.0743
Flex3	0.4350	0.0573	4.2800	0.1178
Flex4	0.1586	0.0003	12.7100	0.0017
Int1	0.0035	0.6628	8.0000	0.0184
Int2	0.0011	0.8943	9.5300	0.0085
Int3	0.0113	0.4017	6.7300	0.0346
Int4	0.0184	0.9116	5.4900	0.0642
Info1	0.0017	0.0258	12.5600	0.0019
Info2	0.0003	0.0724	13.9400	0.0009
Info3	0.0093	0.8427	6.4800	0.0391
Info4	0.1086	0.4005	3.3200	0.1897
Sys1	0.0009	0.0850	12.2000	0.0025
Sys2	0.0001	0.0952	14.4100	0.0007
Sys3	0.0005	0.0733	13.1000	0.0014
Sys4	0.0000	0.0416	19.6500	0.0001
Use1	0.0000	0.1353	16.7000	0.0002

			Joint	
	Pr(Skewness)	**Pr(Kurtosis)**	**adj $\chi^2(2)$**	**Pr > χ^2**
Use2	0.0006	0.3832	10.9600	0.0042
Use3	0.0001	0.1036	15.7200	0.0004
Use4	0.0000	0.1234	15.6400	0.0004
Use5	0.0000	0.0073	22.3800	0.0000
Use6	0.0000	0.0098	20.8900	0.0000
Satis1	0.0026	0.4867	8.6300	0.0134
Satis2	0.0047	0.8453	7.4400	0.0242
Satis3	0.0025	0.5640	8.5900	0.0137
Satis4	0.0004	0.4466	11.4600	0.0032
Cost1	0.0000	0.0099	19.8800	0.0000
Cost2	0.0401	0.8828	4.2900	0.1171
Cost3	0.0030	0.2347	9.1200	0.0104
Cost4	0.0913	0.4025	3.6000	0.1655
Coop1	0.0165	0.6198	5.8400	0.0540
Coop2	0.1087	0.4101	3.2900	0.1926
Coop3	0.4402	0.0860	3.5900	0.1661
Coop4	0.0005	0.1155	12.3500	0.0021
Unc1	0.0189	0.8910	5.4600	0.0653
Unc2	0.0085	0.0644	9.2300	0.0099
Unc3	0.0306	0.9169	4.7500	0.0931
Unc4	0.0003	0.1887	12.6700	0.0018

Tests for skewness, kurtosis and joint test for univariate normality with original data.

A6 Univariate Normality Tests for Transformed Items

			Joint	
	Pr(Skewness)	**Pr(Kurtosis)**	**adj $\chi^2(2)$**	**Pr > χ^2**
Acc1	0.8347	0.8161	0.1000	0.9524
Acc2	0.9095	0.1903	1.7500	0.4168
Acc3	0.4922	0.9889	0.4800	0.7879
Acc4	0.6458	0.2262	1.7000	0.4281
Comp1	0.5084	0.0700	3.7700	0.1518
Comp2	0.5420	0.5731	0.7000	0.7057
Comp3	0.3326	0.2413	2.3400	0.3101
Comp4	0.0005	0.7339	10.6200	0.0049
Curr1	0.6784	0.2080	1.7800	0.4108
Curr2	0.9115	0.6262	0.2500	0.8827
Curr3	0.4793	0.2691	1.7400	0.4182
Curr4	0.5389	0.6361	0.6100	0.7378
Form1	0.1229	0.3849	3.1800	0.2043
Form2	0.8249	0.6003	0.3200	0.8507
Form3	0.6432	0.8447	0.2500	0.8812
Form4	0.0972	0.0098	8.5200	0.0141
Access1	0.5725	0.0888	3.2600	0.1963
Access2	0.6073	0.7958	0.3300	0.8474
Access3	0.9582	0.2812	1.1800	0.5548
Access4	0.3576	0.0463	4.8800	0.0872
Rel1	0.3982	0.8226	0.7700	0.6795
Rel2	0.4698	0.9465	0.5300	0.7663

			Joint	
	Pr(Skewness)	**Pr(Kurtosis)**	**adj $\chi^2(2)$**	**Pr > χ^2**
Rel3	0.9049	0.3687	0.8300	0.6597
Rel4	0.3113	0.6394	1.2600	0.5326
Resp1	0.9107	0.0012	9.4100	0.0091
Resp2	0.8312	0.5811	0.3500	0.8381
Resp3	0.6489	0.2963	1.3100	0.5184
Resp4	0.5903	0.3558	1.1600	0.5609
Flex1	0.4631	0.1416	2.7300	0.2549
Flex2	0.0009	0.5651	10.0000	0.0067
Flex3	0.0000	0.3730	15.1000	0.0005
Flex4	0.1289	0.0027	9.9800	0.0068
Int1	0.9195	0.1031	2.7000	0.2591
Int2	0.5400	0.0161	5.9700	0.0505
Int3	0.6547	0.0226	5.3500	0.0688
Int4	0.2110	0.2007	3.2400	0.1975
Info1	0.4771	0.6985	0.6600	0.7179
Info2	0.9505	0.7538	0.1000	0.9502
Info3	0.6441	0.4404	0.8200	0.6643
Info4	0.0277	0.5322	5.2200	0.0735
Sys1	0.7642	0.9804	0.0900	0.9557
Sys2	0.8237	0.5313	0.4500	0.8001
Sys3	0.9512	0.8000	0.0700	0.9666
Sys4	0.3080	0.6222	1.3000	0.5226
Use1	0.1248	0.2456	3.7500	0.1531

			Joint	
	Pr(Skewness)	**Pr(Kurtosis)**	**adj $\chi^2(2)$**	**Pr > χ^2**
Use2	0.5503	0.1263	2.7300	0.2555
Use3	0.2463	0.3500	2.2500	0.3252
Use4	0.2330	0.3534	2.3100	0.3146
Use5	0.1838	0.4761	2.3000	0.3161
Use6	0.1396	0.5712	2.5400	0.2815
Satis1	0.9411	0.4832	0.5000	0.7779
Satis2	0.8141	0.4894	0.5400	0.7638
Satis3	0.9801	0.2860	1.1500	0.5620
Satis4	0.6101	0.7855	0.3300	0.8462
Cost1	0.9917	0.8541	0.0300	0.9832
Cost2	0.0970	0.2652	2.5000	0.1321
Cost3	0.2351	0.4470	2.1000	0.3654
Cost4	0.0623	0.3179	4.5300	0.1037
Coop1	0.5577	0.3066	1.4100	0.4950
Coop2	0.0505	0.2633	5.9000	0.0785
Coop3	0.0023	0.8107	8.4400	0.0147
Coop4	0.5736	0.5920	0.6100	0.7369
Unc1	0.4378	0.7690	0.7000	0.7061
Unc2	0.5457	0.9973	0.3700	0.8317
Unc3	0.3688	0.5290	1.2200	0.5437
Unc4	0.7246	0.3257	1.1000	0.5760

Tests for skewness, kurtosis and joint test for univariate normality with transformed data.

A7 Confirmatory Factor Analysis for Items

	df	X^2	$p > \chi^2$	RMSEA	CFI	TLI	SRMR	CD
Accuracy	2	6.535	0.038	0.113	0.985	0.956	0.022	0.867
Completeness	2	2.251	0.324	0.027	0.999	0.997	0.014	0.851
Currency	2	32.583	0.000	0.294	0.910	0.730	0.043	0.867
Format	2	3.228	0.199	0.059	0.996	0.988	0.019	0.895
Accessibility	2	11.625	0.003	0.165	0.975	0.926	0.025	0.900
Reliability	2	1.787	0.409	0.000	1.000	1.001	0.007	0.922
Response Time	2	4.465	0.107	0.083	0.991	0.972	0.024	0.897
Flexibility	2	3.787	0.151	0.071	0.994	0.982	0.018	0.894
Integration	2	0.432	0.806	0.000	1.000	1.011	0.005	0.925
Information Quality	2	3.459	0.177	0.064	0.996	0.988	0.015	0.900
System Quality	2	3.518	0.172	0.065	0.997	0.991	0.012	0.935
Perceived Usefulness	9	23.216	0.006	0.094	0.987	0.979	0.016	0.962
Satisfaction	2	3.024	0.220	0.054	0.998	0.993	0.010	0.907
Cost Savings	2	0.350	0.840	0.000	1.000	1.021	0.006	0.832
Better Cooperation	2	9.780	0.008	0.148	0.973	0.918	0.030	0.866
Reduced Uncertainty	2	10.153	0.006	0.152	0.951	0.854	0.036	0.773

Goodness-of-fit indices of CFA for items.

A8 Cronbach's α for Items

	Average inter-item correlation	Scale reliability coefficient (α)
Accuracy	0.5959	0.8550
Completeness	0.5506	0.8305
Currency	0.6007	0.8575
Format	0.5243	0.8151
Accessibility	0.6492	0.8810
Reliability	0.3358	0.9180
Response Time	0.5163	0.8102
Flexibility	0.4734	0.7824
Integration	0.6651	0.8882
Information Quality	0.6181	0.8662
System Quality	0.7324	0.9163
Perceived Usefulness	0.7835	0.9560
Satisfaction	0.7072	0.9062
Cost Savings	0.5272	0.8169
Better Cooperation	0.5334	0.8205
Reduced Uncertainty	0.4368	0.7562

Cronbach's α for items pertaining to their construct.

A9 Paramater Estimates for Transformed Data

From	To	Coef.	Std. Err.	z	P>|z|	95% Conf. Int.	
Accuracy	**Acc1**	1.0000	(const.)				
	Acc2	0.9973	0.0848	11.76	0.000	0.8311	1.1635
	Acc3	0.8865	0.0761	11.65	0.000	0.7373	1.0357
	Acc4	0.9472	0.0938	10.10	0.000	0.7633	1.1310
Completeness	**Comp1**	1.0000	(const.)				
	Comp2	0.8194	0.0888	9.23	0.000	0.6453	0.9934
	Comp3	0.8738	0.0844	10.36	0.000	0.7084	1.0392
	Comp4	0.8440	0.0878	9.61	0.000	0.6718	1.0161
Currrency	**Curr1**	1.0000	(const.)				
	Curr2	0.9842	0.0902	10.91	0.000	0.8073	1.1610
	Curr3	0.9641	0.1024	9.42	0.000	0.7635	1.1647
	Curr4	1.0578	0.0988	10.70	0.000	0.8641	1.2515
Format	**Form1**	1.0000	(const.)				
	Form2	1.0060	0.0745	13.50	0.000	0.8599	1.1520
	Form3	0.8656	0.0750	11.54	0.000	0.7186	1.0127
	Form4	0.5943	0.0955	6.22	0.000	0.4071	0.7814
Accessibility	**Access1**	1.0000	(const.)				
	Access2	1.0341	0.1107	9.34	0.000	0.8171	1.2511
	Access3	1.2856	0.1259	10.21	0.000	1.0388	1.5324
	Access4	1.2822	0.1252	10.24	0.000	1.0368	1.5276
Reliability	**Rel1**	1.0000	(const.)				
	Rel2	0.9672	0.0638	15.16	0.000	0.8421	1.0923
	Rel3	1.0806	0.0653	16.55	0.000	0.9526	1.2085
	Rel4	0.9106	0.0647	14.70	0.000	0.7837	1.0374
Response Time	**Resp1**	1.0000	(const.)				
	Resp2	0.8619	0.1240	6.95	0.000	0.6189	1.1049

From	To	Coef.	Std. Err.	z	P>|z|	95% Conf. Int.	
	Resp3	1.2558	0.1521	8.26	0.000	0.9577	1.5538
	Resp4	1.1318	0.1408	8.40	0.000	0.8558	1.4079
Flexibility	**Flex1**	1.0000	(const.)				
	Flex2	1.1463	0.1030	11.12	0.000	0.9444	1.3483
	Flex3	-0.9151	0.0852	-10.74	0.000	-1.0821	-0.7481
	Flex4	-0.3363	0.1142	-2.95	0.003	-0.5600	-0.1125
Integration	**Int1**	1.0000	(const.)				
	Int2	0.8545	0.0657	13.00	0.000	0.7257	0.9834
	Int3	1.0286	0.0570	18.50	0.000	0.9170	1.1403
	Int4	0.7316	0.0687	10.64	0.000	0.5969	0.8663
Information Quality	**Info1**	1.0000	(const.)				
	Info2	1.0255	0.0689	14.87	0.000	0.8904	1.1607
	Info3	1.0083	0.0773	13.40	0.000	0.8567	1.1599
	Info4	0.8503	0.0874	9.73	0.000	0.6790	1.0216
System Quality	**Sys1**	1.0000	(const.)				
	Sys2	1.1257	0.0647	17.40	0.000	0.9989	1.2526
	Sys3	1.0483	0.0635	16.50	0.000	0.9238	1.1728
	Sys4	0.8504	0.0682	12.47	0.000	0.7166	0.9841
Perceived Usefulness	**Use1**	1.0000	(const.)				
	Use2	0.9966	0.0663	15.40	0.000	0.8667	1.1265
	Use3	1.0644	0.0618	17.22	0.000	0.9433	1.1856
	Use4	1.0617	0.0628	16.90	0.000	0.9386	1.1849
	Use5	1.0110	0.0635	15.92	0.000	0.8866	1.1355
	Use6	0.9678	0.0603	16.40	0.000	0.8495	1.0860
Satisfaction	**Satis1**	1.0000	(const.)				
	Satis2	1.0410	0.0775	13.43	0.000	0.8891	1.1929
	Satis3	1.0614	0.0784	13.54	0.000	0.9078	1.2150

From	To	Coef.	Std. Err.	z	P>|z|	95% Conf. Int.	
	Satis4	1.0244	0.0783	13.90	0.000	0.8710	1.1778
Cost Savings	**Cost1**	1.0000	(const.)				
	Cost2	1.1668	0.1272	9.18	0.000	0.9176	1.4160
	Cost3	0.9015	0.1192	7.56	0.000	0.6679	1.1352
	Cost4	0.9886	0.1179	8.38	0.000	0.7575	1.2197
Better Cooperation	**Coop1**	1.0000	(const.)				
	Coop2	0.9812	0.0905	10.84	0.000	0.8038	1.1587
	Coop3	0.5820	0.0950	6.13	0.000	0.3958	0.7682
	Coop4	0.9802	0.0857	11.44	0.000	0.8122	1.1481
Reduced Uncertainty	**Unc1**	1.0000	(const.)				
	Unc2	1.2194	0.1572	7.76	0.000	0.9114	1.5275
	Unc3	1.1235	0.1533	7.33	0.000	0.8230	1.4241
	Unc4	1.0576	0.1661	6.37	0.000	0.7320	1.3831

Factor loadings for transformed data.

From	To	Coef.	Std. Err.	z	P>|z|	95% Conf. Int.	
Accuracy	**Information Quality**	0.5198	0.0715	7.27	0.000	0.3796	0.6599
Completeness		0.2066	0.0581	3.55	0.000	0.0927	0.3205
Currency		0.1250	0.0599	2.90	0.037	0.0076	0.2423
Format		0.2437	0.0512	4.76	0.000	0.1434	0.3440
Information Quality	**Perceived Usefulness**	0.2565	0.1132	2.27	0.023	0.0347	0.4783
System Quality		0.5623	0.1112	5.60	0.000	0.3444	0.7803
Information Quality	**Satisfaction**	0.2037	0.0555	3.67	0.000	0.0949	0.3124
Perceived Usefulnes		0.3642	0.0506	7.20	0.000	0.2650	0.4634
System Quality		0.4718	0.0664	7.10	0.000	0.3416	0.6020
Accessibility	**System**	0.2528	0.0850	2.97	0.003	0.0862	0.4194

From	To	Coef.	Std. Err.	z	P>|z|	95% Conf. Int.	
Reliability	**Quality**	0.4804	0.0768	6.26	0.000	0.3299	0.6308
Response Time		-0.0090	0.0789	-0.11	0.909	-0.1636	0.1456
Flexibility		0.2449	0.0629	3.90	0.000	0.1217	0.3681
Integration		0.1999	0.0478	4.18	0.000	0.1063	0.2936
Perceived Usefulness	**Cost Savings**	-0.1531	0.1327	-1.15	0.249	-0.4132	0.1070
Satisfaction		0.6980	0.1610	4.33	0.000	0.3824	1.0137
Perceived Usefulness	**Better Cooperation**	-0.3457	0.1559	-2.22	0.027	-0.6511	-0.0402
Satisfaction		0.9045	0.1846	4.90	0.000	0.5427	1.2662
Perceived Usefulness	**Reduced Uncertainty**	0.0812	0.0894	0.91	0.364	-0.0940	0.2564
Satisfaction		0.5207	0.1172	4.44	0.000	0.2910	0.7504

Coefficients for transformed data.

	Coef.	Std. Err.	95% Conf. Interval	
Errors related to items				
Acc1	9.0516	1.4962	6.5467	12.5150
Acc2	15.2079	2.0485	11.6792	19.8028
Acc3	10.3735	1.4426	7.8986	13.6239
Acc4	17.8515	2.3030	13.8631	22.9873
Comp1	10.1122	2.0104	6.8488	14.9304
Comp2	18.3809	2.4002	14.2304	23.7421
Comp3	15.4593	2.1402	11.7855	20.2783
Comp4	19.8077	2.5217	15.4337	25.4214
Curr1	13.6528	1.9755	10.2815	18.1295
Curr2	11.8994	1.8475	8.7774	16.1318

	Coef.	Std. Err.	95% Conf. Interval	
Curr3	13.5736	1.9004	10.3163	17.8595
Curr4	8.8363	1.6654	6.1071	12.7850
Form1	7.9168	1.5755	5.3598	11.6935
Form2	7.5932	1.5510	5.0881	11.3317
Form3	14.2057	1.8172	11.0555	18.2535
Form4	34.6803	3.8127	27.9579	43.0191
Access1	17.6949	2.1591	13.9312	22.4754
Access2	13.0140	1.6902	10.0893	16.7864
Access3	7.4938	1.4430	5.1379	10.9298
Access4	10.5748	1.6567	7.7789	14.3757
Rel1	5.6611	0.8668	4.1934	7.6424
Rel2	7.3353	1.0049	5.6080	9.5946
Rel3	6.8690	1.0392	5.1065	9.2399
Rel4	8.3484	1.0880	6.4664	10.7780
Resp1	29.3557	3.4134	23.3732	36.8695
Resp2	17.2195	2.0434	13.6462	21.7285
Resp3	5.7025	1.8649	3.0040	10.8250
Resp4	13.5000	2.1142	9.9319	18.3500
Flex1	15.4328	2.1098	11.8053	20.1750
Flex2	9.1282	1.9807	5.9660	13.9663
Flex3	8.7389	1.4581	6.3013	12.1195
Flex4	41.4913	4.4571	33.6138	51.2148
Int1	6.3633	1.2553	4.3228	9.3670
Int2	16.8915	2.0274	13.3507	21.3714
Int3	6.3816	1.3057	4.2734	9.5298

	Coef.	Std. Err.	95% Conf. Interval	
Int4	19.9601	2.2855	15.9477	24.9821
Info1	7.1025	1.0282	5.3480	9.4326
Info2	8.1105	1.1506	6.1417	10.7103
Info3	11.6802	1.4829	9.1071	14.9802
Info4	19.0858	2.2189	15.1966	23.9702
Sys1	7.6493	0.9805	5.9499	9.8341
Sys2	6.0577	0.9129	4.5085	8.1393
Sys3	6.7302	0.9194	5.1494	8.7965
Sys4	12.1249	1.4105	9.6529	15.2299
Use1	10.6823	1.2667	8.4669	13.4773
Use2	9.2877	1.1118	7.3453	11.7437
Use3	4.8367	0.6884	3.6594	6.3929
Use4	5.5344	0.7503	4.2430	7.2188
Use5	7.4803	0.9299	5.8628	9.5441
Use6	6.5773	0.8242	5.1450	8.4083
Satis1	11.3266	1.3202	9.0133	14.2335
Satis2	9.6749	1.1475	7.6681	12.2069
Satis3	9.8625	1.1850	7.7931	12.4813
Satis4	10.5886	1.2569	8.3908	13.3621
Cost1	14.7431	2.0931	11.1621	19.4730
Cost2	13.0627	2.2218	9.3595	18.2312
Cost3	21.6974	2.6564	17.0685	27.5817
Cost4	18.4541	2.4075	14.2905	23.8309
Coop1	10.2017	1.7703	7.2605	14.3344
Coop2	14.0966	2.0731	10.5666	18.8058

	Coef.	Std. Err.	95% Conf. Interval	
Coop3	27.7223	3.1020	22.2630	34.5203
Coop4	11.7707	1.8299	8.6790	15.9636
Unc1	18.8181	2.2698	14.8562	23.8367
Unc2	9.7145	1.5337	7.1291	13.2374
Unc3	16.8369	2.1436	13.1187	21.6089
Unc4	23.2211	2.7405	18.4257	29.2645
Errors related to endogenous latent variables				
Information Quality	3.6798	0.8969	2.2822	5.9333
Perceived Usefulness	13.4816	2.0300	10.0362	18.1098
Satisfaction	0.9456	0.3908	0.4207	2.1257
System Quality	5.0018	0.9028	3.5114	7.1247
Cost Savings	10.8489	2.1904	7.3034	16.1156
Better Cooperation	15.9200	2.6337	11.5114	22.0170
Reduced Uncertainty	3.6151	1.0562	2.0390	6.4094
Variances of exogenous latent variables				
Accuracy	22.3916	3.3998	16.6281	30.1526
Completeness	26.4090	4.0990	19.4820	35.7988
Currency	20.5290	3.5906	14.5710	28.9232
Format	26.0619	3.7565	19.6478	34.5698
Accessibility	16.8487	3.3270	11.4416	24.8111
Reliability	20.5426	2.7903	15.7412	26.8085
Response Time	16.9994	4.0567	10.6489	27.1370
Flexibility	22.0126	3.8617	15.6079	31.0455
Integation	31.9976	4.1579	24.8032	41.2788

Error variances of items and endogenous latent variables and variances of exogenous latent variables.

	Variance					
	fitted	predicted	residual	R^2	mc	mc^2
Items						
Acc1	31.4431	22.3916	9.0516	0.71	0.8439	0.7121
Acc2	37.4793	22.2714	15.2079	0.59	0.7709	0.5942
Acc3	27.9715	17.5980	10.3735	0.63	0.7932	0.6291
Acc4	37.9391	20.0876	17.8515	0.53	0.7276	0.5295
Comp1	36.5211	26.4090	10.1122	0.72	0.8504	0.7231
Comp2	36.1102	17.7292	18.3809	0.49	0.7007	0.4910
Comp3	35.6222	20.1629	15.4593	0.57	0.7523	0.5660
Comp4	38.6183	18.8106	19.8077	0.49	0.6979	0.4871
Curr1	34.1818	20.5290	13.6528	0.60	0.7750	0.6006
Curr2	31.7828	19.8835	11.8994	0.63	0.7910	0.6256
Curr3	32.6561	19.0825	13.5736	0.58	0.7644	0.5843
Curr4	31.8074	22.9711	8.8363	0.72	0.8498	0.7222
Form1	33.9786	26.0619	7.9168	0.77	0.8758	0.7670
Form2	33.9664	26.3731	7.5932	0.78	0.8812	0.7764
Form3	33.7342	19.5286	14.2057	0.58	0.7609	0.5789
Form4	43.8850	9.2047	34.6803	0.21	0.4580	0.2097
Access1	34.5436	16.8487	17.6949	0.49	0.6984	0.4878
Access2	31.0298	18.0159	13.0140	0.58	0.7620	0.5806
Access3	35.3411	27.8473	7.4938	0.79	0.8877	0.7880
Access4	38.2729	27.6981	10.5748	0.72	0.8507	0.7237
Rel1	26.2037	20.5426	5.6611	0.78	0.8854	0.7840
Rel2	26.5516	19.2162	7.3353	0.72	0.8507	0.7237
Rel3	30.8546	23.9856	6.8690	0.78	0.8817	0.7774
Rel4	25.3803	17.0320	8.3484	0.67	0.8192	0.6711
Resp1	46.3551	16.9994	29.3557	0.37	0.6056	0.3667
Resp2	29.8478	12.6283	17.2195	0.42	0.6505	0.4231

	Variance					
	fitted	**predicted**	**residual**	**R^2**	**mc**	**mc^2**
Resp3	32.5103	26.8078	5.7025	0.82	0.9081	0.8246
Resp4	35.2771	21.7771	13.5000	0.62	0.7857	0.6173
Flex1	37.4454	22.0126	15.4328	0.59	0.7667	0.5879
Flex2	38.0550	28.9269	9.1282	0.76	0.8719	0.7601
Flex3	27.1727	18.4338	8.7389	0.68	0.8236	0.6784
Flex4	43.9805	2.4892	41.4913	0.06	0.2379	0.0566
Int1	38.3609	31.9976	6.3633	0.83	0.9133	0.8341
Int2	40.2563	23.3648	16.8915	0.58	0.7618	0.5804
Int3	40.2372	33.8556	6.3816	0.84	0.9173	0.8414
Int4	37.0863	17.1262	19.9601	0.46	0.6796	0.4618
Info1	19.8271	12.7246	7.1025	0.64	0.8011	0.6418
Info2	21.4930	13.3826	8.1105	0.62	0.7891	0.6226
Info3	24.6161	12.9360	11.6802	0.53	0.7249	0.5255
Info4	28.2853	9.1995	19.0858	0.33	0.5703	0.3252
Sys1	21.0690	13.4197	7.6493	0.64	0.7981	0.6369
Sys2	23.0639	17.0063	6.0577	0.74	0.8587	0.7374
Sys3	21.4779	14.7476	6.7302	0.69	0.8286	0.6866
Sys4	21.8287	9.7038	12.1249	0.44	0.6667	0.4445
Use1	29.2445	18.5622	10.6823	0.63	0.7967	0.6347
Use2	27.7237	18.4360	9.2877	0.66	0.8155	0.6650
Use3	25.8679	21.0312	4.8367	0.81	0.9017	0.8130
Use4	26.4596	20.9252	5.5344	0.79	0.8893	0.7908
Use5	26.4544	18.9740	7.4803	0.72	0.8469	0.7172
Use6	23.9626	17.3853	6.5773	0.73	0.8518	0.7255
Satis1	21.3255	9.9990	11.3266	0.47	0.6847	0.4689
Satis2	20.5106	10.8357	9.6749	0.53	0.7268	0.5283

	Variance					
	fitted	**predicted**	**residual**	**R^2**	**mc**	**mc^2**
Satis3	21.1273	11.2649	9.8625	0.53	0.7302	0.5332
Satis4	21.0813	10.4926	10.5886	0.50	0.7055	0.4977
Cost1	28.5512	13.8081	14.7431	0.48	0.6954	0.4836
Cost2	31.8611	18.7984	13.0627	0.59	0.7681	0.5900
Cost3	32.9204	11.2229	21.6974	0.34	0.5839	0.3409
Cost4	31.9490	13.4949	18.4541	0.42	0.6499	0.4224
Coop1	29.6509	19.4492	10.2017	0.66	0.8099	0.6559
Coop2	32.8223	18.7257	14.0966	0.57	0.7553	0.5705
Coop3	34.3093	6.5870	27.7223	0.19	0.4382	0.1920
Coop4	30.4554	18.6847	11.7707	0.61	0.7833	0.6135
Unc1	26.1957	7.3775	18.8181	0.28	0.5307	0.2816
Unc2	20.6849	10.9704	9.7145	0.53	0.7283	0.5304
Unc3	26.1500	9.3131	16.8369	0.36	0.5968	0.3561
Unc4	31.4725	8.2515	23.2211	0.26	0.5120	0.2622
Endogenous latent variables						
Information Quality	12.7246	9.0448	3.6798	0.71	0.8431	0.7108
System Quality	13.4197	8.4179	5.0018	0.63	0.7920	0.6273
Perceived Usefulness	18.5622	5.0806	13.4816	0.27	0.5232	0.2737
Satisfaction	9.9990	9.0534	0.9456	0.91	0.9515	0.9054
Cost Savings	13.8081	2.9592	10.8489	0.21	0.4629	0.2143
Better Cooperation	19.4492	3.5292	15.9200	0.18	0.4260	0.1815
Reduced Uncertainty	7.3775	3.7624	3.6151	0.51	0.7141	0.5100

Variance and predictability of dependent variables for transformed data.

A10 Model Fit for Transformed Data

	Value	Description
Likelihood ratio		
χ^2	3,939.484	model vs. saturated
Degrees of Freedom	2059	
$p > \chi^2$	0.000	
Population error		
RMSEA	0.072	Root mean squared error of approximation
90% CI, lower bound	0.000	
upper bound	NA	
pclose	NA	Probability RMSEA ≤ 0.05
Baseline comparison		
CFI	0.794	Comparative fit index
TLI	0.785	Tucker-Lewis index
Size of residuals		
SRMR	0.290	Standardised root mean squared residual
CD	1.000	Coefficient of determination

Fit statistics for transformed data.